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BAWDEN (F. C.). **Plant Viruses and Virus Diseases.**—10½×6¾ ins., 3rd edn. revd., xv+335 pp., frontis., 59 figs., many refs. Waltham, Mass., Chronica Botanica Co. ; London, W. Dawson & Sons, Ltd., 1950. Price $6.

The subject matter of this edition resembles that of the previous one [*R.A.E.*, A **33** 192], but the text has been largely rewritten and greatly extended to bring it up to date. A chapter on the quantitative estimation of plant viruses has been added.

GRANDORI (R.). **Esperimento di lotta contro la mosca delle olive** (*Dacus oleae* **Rossi) mediante lancio di polvere di Gesarol D.D.T. dall'aeroplano.** [An Experiment on the Control of the Olive Fly, *Dacus oleae* (Gmel.), by a Dust of DDT Gesarol applied from an Aeroplane.]—*Boll. Zool. agr. Bachic. Milano* **14** fasc. 1 pp. 1–23, 1 map, 3 figs. Turin, 1947. (With Summaries in French, English and German.)

Following a laboratory test showing that DDT is toxic to adults of *Dacus oleae* (Gmel.), a large-scale experiment on the control of this Trypetid in olive groves by dusting from an aeroplane was made near Milan in 1946. DDT was obtained in the form of a Gesarol dust [of unstated concentration], and since the adults of the overwintered generation emerge in that area towards the end of June but do not oviposit until 4th–5th July and the later generations overlap considerably, ten applications were made between 30th June and 30th September ; additional treatment from the ground was made in September or early October. Dusting was done in the early morning, and it is calculated that the dust was applied at an average total rate of 4·11 gm. per sq. metre, but as about a third was lost owing to drift, the total amount that reached the trees averaged only about 2·74 gm. per sq. metre. Coverage in practice was very variable. Samples of olives were examined in October, and the percentages uninfested averaged 80·31 in a grove that received very thorough treatment, 70 in one that received good treatment and 47·96 in groves poorly treated, as compared with 29·87 in untreated groves.

JENKINS (C. F. H.). **The Argentine Ant** (*Iridomyrmex humilis* **Mayr**).—*J. Dep. Agric. W. Aust.* (2) **25** no. 3 pp. 245–258, 7 figs., 11 refs. Perth, W.A., 1948.

Iridomyrmex humilis (Mayr), which was introduced into Western Australia in 1941 [*R.A.E.*, A **32** 227], is well established at Albany and Perth and isolated outbreaks have occurred at three other places ; it has not reached the main orchard districts. Its biology and importance as a household pest and in fostering Aphids and Coccids on fruit trees, and measures for its control, are reviewed, mainly from the literature. In addition to the usual measures, particularly the use of poison baits, dusts containing 2–10 per cent. DDT for sprinkling in and round the entrances to the nests and sprays of DDT in water or oil [*cf.* **35** 115] for use on or in buildings are recommended. A water spray containing 2 per cent. DDT should be used on the foundations of infested houses and on paths, fences, shrubs and flower borders, and as much as 20 gals. per ¼ acre may be required for the initial treatment of a heavily infested area with buildings and gardens. For indoor infestations, a spray containing 3 or 4 per cent. DDT in kerosene is recommended. The spray of 2 per cent. DDT in water can also be used on the butts and main branches of infested fruit trees. In tests, an emulsion containing only 1 per cent. DDT kept trees free from the ants for seven weeks, and infestation was still only slight at the end of 14 weeks.

(202) Wt. P2701/3853 4/51 S.E.R. Ltd. Gp. 432. [A]

JENKINS (C. F. H.). **The Banana as a Host Fruit of the Mediterranean Fruit Fly.**—*J. Dep. Agric. W. Aust.* (2) **25** no. 3 pp. 263–264, 1 fig., 8 refs. Perth, W.A., 1948.

Ceratitis capitata (Wied.) has been known in Western Australia since 1895, and general experience there has confirmed the view that banana is not a suitable host-fruit for it [*cf. R.A.E.*, A **4** 134]. In 1947, however, it severely infested bananas and plantains in the Carnarvon district, where it was first recorded in 1934 and had commonly attacked *Citrus*, figs and other recognised host-fruits. Numerous adults were reared from bananas picked green and in accordance with commercial practice, though mould developed on some of the fruits and prevented the larvae from completing their development. An infested fruit was also received from a commercial market. The activity of the fly at Carnarvon and possibly its adaptation to bananas may have been promoted by the presence of neglected plantations and by failure to remove the fruits from plantains used as windbreaks. There is some evidence that its host-fruit relations may change in different countries, since it does not attack tomatos or cucumbers in Western Australia and does not readily infest grapes there, though it appears to be doing so more frequently than it did formerly.

MAY (A. W. S.). **Codling Moth and Light Brown Apple Moth Control Experiments, 1948–49.**—*Qd agric. J.* **69** pt. 6 pp. 340–343. Brisbane, 1949.

In view of the results of experiments with sprays of DDT against *Cydia pomonella* (L.) on apple in Queensland in 1947–48 [*R.A.E.*, A **37** 102], the possibility of obtaining adequate control with fewer than six cover sprays was investigated in 1948–49 in two widely separated orchards of a late-maturing variety. The trees received a dormant or semi-dormant oil spray for the control of mites, a calyx spray of lead arsenate, and a spray of HETP (hexaethyl tetraphosphate) in early summer for the control of mites and *Eriosoma lanigerum* (Hsm.). The DDT sprays were prepared from emulsion concentrates, and cover sprays of 0·1 per cent. DDT were applied on all or some of six dates about three weeks apart between 1st November and 15th February. Cover sprays 1 and 4 coincided with periods of peak activity of adults of *C. pomonella*, and 2 and 5 were particularly effective against *Tortrix postvittana* (Wlk.). The total percentages of sound fruit and of fruit injured by each of these two species are shown in a table. The proportion of fruit with only superficial injuries by *C. pomonella* was highest on the trees that received all six applications and decreased with the number of sprays applied. The percentage of sound fruit was greatest (92·2 and 93·8 as compared with 56·6 and 61·5 for no treatment) on trees that received six cover sprays. The percentages damaged by *C. pomonella* were 3 for the complete schedule, about 6 for cover sprays 1, 2, 4, and 5 or 6, about 10 for cover sprays 1, 2 and 4, about 15 for cover sprays 1 and 4 only, and 16·7 (in one orchard only) for cover spray 1 alone, as compared with just over 27 for no treatment. When the concentration was doubled, cover spray 1 alone was better than sprays 1 and 4 at 0·1 per cent. The percentages damaged by *T. postvittana* ranged from a little over 2 for all six applications of 0·1 per cent. DDT to nearly 9 for the first only (in one orchard) and in general was reduced as the number of sprays increased.

Bryobia praetiosa Koch and *Tetranychus telarius* (L.) (*urticae* Koch) were slightly more numerous on the experimental trees than on the controls, but their numbers were not excessive and did not differ on trees that received the different schedules. *Eriosoma lanigerum* was prevalent in one orchard early in the season and persisted until summer. Its parasite, *Aphelinus mali* (Hald.), was checked by the early applications of DDT, but increases in *E. lanigerum*

were not correlated with the number of DDT sprays, and the differences in populations at midsummer were similar to those observed earlier in the season. The Aphid was controlled by mid-January as a result of increased parasite activity and the HETP spray. These tests indicate the necessity for checking populations as early as possible, preferably by early summer ; HETP applied at this time against mites is effective against the Aphid if applied thoroughly at high pressure.

The schedule recommended on the basis of these trials comprises two applications of DDT three weeks apart against late-spring infestation by *C. pomonella* and early-summer infestation by *T. postvittana*, followed by two others also three weeks apart in January. Applications should be made according to moth-trapping records. A dormant or semi-dormant oil spray and a thorough application of HETP before midsummer is recommended for the control of mites and *E. lanigerum*.

HELY (P. C.). **Control of Fruit Fly under Backyard Conditions ; Value of Nicotine Sulphate Baits.**—*Agric. Gaz. N.S.W.* **60** pt. 3 pp. 143–146, 2 refs. Sydney. 1949.

Fruit trees of different varieties growing in private gardens in New South Wales become attractive to *Dacus* (*Strumeta*) *ferrugineus tryoni* (Frogg.) at different times, so that the numbers of flies attracted to individual trees may be great and insufficient protection is afforded them by the measures that give control in commercial orchards. Since laboratory tests indicated that bait-sprays containing nicotine sulphate might give sufficiently rapid mortality to protect such trees, tests with them were begun in 1944 on a single peach tree growing in a garden at Gosford. The bait-spray used in that year comprised 1 fl. oz. nicotine sulphate and 1½ lb. sugar in 3 gals. water ; it was applied with a spray pump, and four applications were made, beginning on 3rd December. By 14th December, when the crop was nearly over, 45 fruit-flies had been collected from a quarter of the total area under the tree on which the insects could fall. Fruit-flies that were still moving when collected died within 12 hours. The treatment was too late to prevent much of the fruit from becoming infested but showed promise. In 1946, the same tree was treated by flicking with a brush. The first two applications were made with the same bait-spray as was used in 1944 and the rest with 1 fl. oz. nicotine sulphate, 2 fl. oz. emulsion concentrate containing 20 per cent. DDT and 2 lb. sugar in 4 gals. water, the DDT being added to obviate the possibility of recovering after an insufficient dose. Treatment was begun on 10th November, about a fortnight before the first fruits were due to ripen, and continued for a month, during which 13 applications were made. Of 721 fruits, only 211 were infested, while neighbouring plum and apricot trees were very heavily infested. Treated fruits that contained half-grown larvae from 23rd November onwards were thought to have been attacked between 14th and 19th November when heavy rain prevented treatment. Of the 191 fruit-flies collected from half the area beneath the tree, 80 per cent. were females, all gravid, and it was estimated that the number of fruit-flies affected by the bait-sprays was sufficient to have damaged the entire crop.

In 1947, the same bait-spray of DDT and nicotine sulphate was applied to the tree every few days from early November to 18th December, and usually repeated if rain fell ; rain was recorded on 25 of the 45 days concerned. The first ripe fruits were picked on 23rd November, and of a total of 996 harvested, only 66 were infested. No infested fruit was found in a random sample officially examined on 3rd December, while infestation on a neighbouring peach tree was estimated to be 98 per cent. Affected fruit-flies collected from half the area beneath the tree, of which there were 62, were placed in a cage with a treated

twig in the fork of the tree, and none was alive after eight hours. As a glass fly-trap baited with ammonia and vanilla, which was placed in the tree on 2nd November, caught only two fruit-flies (on 7th November), it was assumed that almost all that visited the tree were eliminated by the bait-spray.

In all the experiments, many fallen fruit-flies were removed by ants, other insects and birds, without which many more would no doubt have been collected. Large numbers of other insects, especially other Diptera, were also affected by the bait-sprays, and the effect of light winds in increasing the numbers of fruit-flies present was evident. There was little activity at temperatures of less than about 70°F. Directions for preparing the bait-spray are given. Treatment should be begun about 4–6 weeks before the first fruits are due to ripen, and applications made every two days, or more often if rain falls.

The European Earwig (*Forficula auricularia*).—*Agric. Gaz. N.S.W.* **60** pt. 4 pp. 200–202, 2 figs., 2 refs. Sydney, 1949.

Forficula auricularia L., which was first recorded in New South Wales in 1934 [*R.A.E.*, A **22** 658], causes considerable damage to garden plants in two districts of the Blue Mountains in some seasons and has also been reported from various other places. Information on its bionomics and control in Tasmania and the United States [**27** 510 ; **30** 274] is reviewed. A bait prepared by mixing 5 oz. dust containing 20 per cent. benzene hexachloride with 12 lb. bran and moistening immediately before application with 1¼ gals. water was used by growers in one district of New South Wales with good results.

Heating in stored Wheat.—*Bull. Coun. sci. industr. Res. Aust.* no. 237, 35 pp., 9 figs., 20 refs. Melbourne, 1948.

This bulletin comprises the three papers noticed below, together with a foreword in which it is stated that the investigations that are their subject were made because intensive study of the problem of insect infestation of stored wheat in Australia during the war had shown the need for a better understanding of the factors involved in the heating of wheat stored in bulk, which has an important effect on the nature and development of insect infestation.

Milthorpe (J.) & Robertson (R. N.). **I. Respiration of dry Grain, Insect Respiration, and Temperature and Moisture Effects,** pp. 9–17. Samples of wheat from New South Wales, Victoria and Western Australia were stored in sealed containers at 27°C. [80·6°F.] and sieved periodically to remove adult insects, which comprised *Calandra oryzae* (L.) in the wheat from New South Wales and *Rhizopertha dominica* (F.) in that from Victoria. Very little carbon dioxide was produced in the absence of the insects (0·005 cu. mm./gm. wet weight/hr. at 27°C. and 9–10 per cent. moisture content), and a high rate of carbon-dioxide production was always associated with the presence of insects. The rate of respiration of the grain increased considerably with increasing moisture content and, to a less extent, temperature.

Robertson (R. N.). **II. Heat Production, Heat Conductivity, and Temperature Rise in Grain in the Presence and Absence of Insects,** pp. 18–29. From observations on a sample of Australian wheat infested by larvae of *Sitotroga cerealella* (Ol.) and examination of data available in the literature, it is concluded that 1 British thermal unit/sq. ft./hr./°F./inch is a reasonable average value for the thermal conductivity of wheat, though it may be rather low for wheat stored in bulk. The expected rise in temperature due to the respiration of wheat stored in bulk is estimated from this value and that for the rate of respiration of dry grain obtained by Milthorpe & Robertson [see above] and found to be negligible. The heat produced by a light infestation of insects distributed evenly through the grain and by a surface infestation is

discussed ; it is concluded that the former, but not the latter, is sufficient to cause the rise in temperature observed in bulk wheat. The diffusibility of carbon dioxide and the concentrations of it likely to be developed in bulk wheat are also discussed. It is concluded that such concentrations are unimportant in influencing the distribution of insects when compared with the rise in temperature that causes insects to leave infested areas [*R.A.E.*, A **34** 121–122]. Temperatures exceeding those to be expected from insect respiration may in part be due to increased respiration of the grain and its microflora situated at the edge of an infestation and made damp by the moisture produced by the respiration of the insects.

ROBERTSON (R. N.) & MILTHORPE (J.). **III. Two Years' Temperature Records of dry Grain in a Concrete Silo,** pp. 30–35. Temperature observations on 900 tons of wheat stored in a bin in New South Wales were made between September 1942 and October 1944, during which the wheat was turned, by being transferred to another bin, at intervals of six or seven weeks. They showed that the temperature of the wheat changed slowly with the seasonal temperature, and that some self-heating occurred. Respiration of the grain itself is shown by calculation to have been insufficient to cause the rise in temperature associated with self-heating. The rise in temperature was associated with an increase in insect infestation, as measured by carbon-dioxide production.

WILSON (F.). **Observations on Wheat in a Victorian Bulk Depot.**—*Bull. Commonw. sci. industr. Res. Org. Aust.* no. 244, 47 pp., 17 figs., 14 refs. Melbourne, 1949.

The following is very largely the author's summary. Systematic observations were made on some 3,400,000 bushels of wheat stored in a single mound in a bulk depot in Victoria for practically three years. The initial wheat temperature was appreciably affected by the seasonal conditions obtaining when the wheat was stored. By the end of the storage period, insect activity had caused the temperature of the general body of wheat to rise, and the increase was as much as 10°C. [18°F.] where the wheat was initially warmest. Data were secured on the rates of temperature changes at different depths in the mound in response to external temperature changes. Curves for annual fluctuation show that the temperature at a depth of 9 ft. fluctuates by only a few degrees [*R.A.E.*, A **34** 122]. Temperatures at any particular depth differ markedly at different parts of the mound, mainly because of differential absorption of radiant energy by the two roof slopes, and this has important effects on insect infestation. The temperature gradients in hot spots take a number of different forms, but the form of which all others are but earlier stages is that in which the temperature increases from the surface to about the 1 ft. level and decreases thereafter. A wheat mound is even more resistant to external influences on its moisture content than on its temperature. Curves of the annual fluctuations in moisture content show that this is practically zero at a depth of 18 inches. Moisture content varies inversely with temperature at different parts of the mound, and this also has important effects on the character of the infestation. Insect infestation caused a slow movement of moisture to the surface of the mound where it normally evaporates. Very cold weather, by preventing evaporation, sometimes causes very high moisture contents at the surface of hot spots with the consequent development of mould. The variation in wheat temperature at equal depths at different parts of the mound resulted in a related variation in the level of insect infestation, minor temperature differences causing major differences in the degree of infestation.

The insects present were *Rhizopertha dominica* (F.), *Oryzaephilus surinamensis* (L.), *Tribolium castaneum* (Hbst.), *Calandra oryzae* (L.), *C. granaria* (L.),

Latheticus oryzae Waterh., and, rarely, *Laemophloeus minutus* (Ol.), of which *Rhizopertha* was by far the most important. There was some succession in the occupying insects, as the environment became modified, *T. castaneum*, *Rhizopertha* and *Latheticus* being the principal insects involved [**34** 230]. The density of *Rhizopertha* near the surface of a hot spot reached as high as 1,000 adults per 1,000 grains under exceptional circumstances. Insect density in the general body of wheat was extremely low. In wheat severely affected by insects, the reduction in weight was shown to be 50 per cent. close to the surface, and 5·7 per cent. for the top 5 ft. of the infested wheat ; of this 5·7 per cent., however, over a half (3·4 per cent.) remained as wheat dust.

Surface fumigation of infested areas with carbon bisulphide [**34** 230 ; **35** 414] was begun about a year after the depot was filled and continued until the wheat was discharged, some parts requiring repeated treatment and others none. Mineral dusts were also used for control [**34** 230 ; **35** 302, 414]. These measures proved satisfactory, losses from insects being slight and the cost negligible. The influence of seasonal changes on the temperature and moisture content of the stored wheat was greatly affected by the structure of the depot [**34** 230], and this modifying influence is shown to promote insect infestation.

When the depot was emptied, the wheat was in excellent condition. An overall loss of weight of 0·29 per cent. was caused by three factors, dust discharged into the atmosphere, insect attack, and moisture evaporation, this last being thought the most important.

Plant Investigations.—*21st Rep. Coun. sci. industr. Res. Aust. 1946–47* pp. 9–19. Canberra [? 1948]. **Entomological Investigations.**—*T.c.* pp. 19–25. **Forest Products Investigations.**—*T.c.* pp. 46–57.

Plant Investigations.—*22nd Rep. Coun. sci. industr. Res. Aust. 1947–48* pp. 9–20. Canberra [? 1949]. **Entomological Investigations.**—*T.c.* pp. 20–26. **Forest Products Investigations.**—*T.c.* pp. 46–58.

Plants.—*1st Rep. Commonw. sci. industr. Res. Org. Aust. 1948–49* pp. 14–28. Canberra [? 1950]. **Entomology.**—*T.c.* pp. 49–55. **Forest Products.**—*T.c.* pp. 67–75.

Work on the biological control of St. John's wort [*Hypericum perforatum*] was continued in Australia during the three years ending 30th June, 1949. *Chrysomela hyperici* Forst. and *C. quadrigemina* Suffr. (*gemellata* Rossi) continued to make excellent progress in the parts of Victoria, New South Wales and South Australia in which they were established against it [*R.A.E.*, A **36** 216], both being present in some. *C. hyperici* was liberated in Western Australia for the first time in November 1947 and made satisfactory progress during 1948–49. It is stated in the first report to be apparently established in Tasmania [*cf.* **33** 321]. Collections of both species were made for liberation in Australia in all three years and for shipment to California [**37** 341] in the first two of them. *Agrilus hyperici* (Crtz.) was less satisfactory than these Chrysomelids, and was probably impeded by the presence of *C. quadrigemina*, but it could still be recovered in 1947–48. Observations in 1948–49 on an area of 150–200 acres in Victoria in which defoliation was complete showed that mortality among the plants was high over only 30 acres, and a similar effect was noted in New South Wales. Heavy and continuous defoliation from early September until the beginning of December, first by the larvae and then by the adults of the Chrysomelids, appears to be necessary to produce high mortality ; plants thus defoliated either for the first time or after recovering from previous heavy attacks were readily killed. Defoliation by the adults alone killed few plants. Old plants were more easily killed than young ones. In some dense stands,

complete defoliation of the flowering shoots stimulated the production of suckers. Evidence was obtained in Victoria that regeneration may be negligible under some circumstances.

The laboratory rearing of *Copidosoma koehleri* Blanch., *Bracon* (*Microbracon*) *gelechiae* Ashm. and *Chelonus phthorimaeae* Gah., and their liberation against *Gnorimoschema operculella* (Zell.) on potato in various States were continued during the three years [*cf.* **36** 216]. Field recoveries of *Copidosoma* in 1946–47 at a place in New South Wales where it had been released in numbers during the two previous years showed that up to 10 per cent. parasitism may be given by succeeding generations. The pupae survived the winter in field cages in this district, but nothing is known as to survival under ordinary conditions. Numerous laboratory-bred consignments of *Omorgus phthorimaeae* Cushm. were received in 1947–48 [*cf.* **36** 216] ; emergence of adults was moderately satisfactory, and liberations against *Gnorimoschema* were made in New South Wales and Victoria. Consignments of *Angitia cerophaga* (Grav.) and *Thyraeella* (*Diadromus*) *collaris* (Grav.) were received from New Zealand during the first two years and mass rearing of both for liberation against the cabbage moth [*Plutella maculipennis* (Curt.)] was continued in all three. *T. collaris* proved difficult to rear, but a satisfactory method was devised in 1947–48 for *A. cerophaga*. Liberations of this species were made in all three years and of *T. collaris* in the last two [*cf.* **38** 455]. In 1948–49, *A. cerophaga* was recovered in Tasmania, New South Wales, the Capital Territory and Queensland, and *T. collaris* in Tasmania and the Capital Territory. Native parasites of *P. maculipennis* reared in 1947–48 included *Hymenobosmina rapi* (Cam.), which is common and attacks the larvae, and *Brachymeria* spp. which attack the pupae. *Apanteles glomeratus* (L.) and *Pteromalus puparum* (L.) are stated in the third report to have exerted a considerable effect on populations of *Pieris rapae* (L.) in the Capital Territory [*cf.* **36** 215], and two consignments of *A. glomeratus* were sent to Tasmania during the year ; this Braconid is hampered in the Capital Territory by a secondary parasite. The Chinese race of *Comperiella bifasciata* How. was again introduced from California [*cf.* **36** 216, etc.] in the last two years and liberated against *Aonidiella aurantii* (Mask.) in Queensland, Victoria and Western Australia in the third. During the same year, the egg-parasite, *Microphanurus basalis* (Woll.), was shipped from New South Wales to New Zealand for liberation against *Nezara viridula* (L.), which had recently become of importance there, and *Teleonemia scrupulosa* Stål (*lantanae* Dist.) was shipped from Queensland to Norfolk Island for the control of *Lantana* ; it survived the winter and exerted a considerable effect on the weed.

Isolated bands of nymphs of *Chortoicetes terminifera* (Wlk.) developed in the Bogan-Macquarie area, New South Wales, at the end of 1948, but were controlled by birds, notably ibis. In the experiments on ecological control at Trangie [*cf.* **36** 216], *Atriplex nummularia* was still the only satisfactory plant for use in barriers separating the oviposition and food-shelter habitats of outbreak centres, though *Tamarix articulata*, which was tested in 1948–49, showed some promise. Wind-blown sand, seeds and seed-heads accumulated in scalds covered by branches [**36** 217], and the soil remained saturated for some time after unprotected scalds had dried out. The seeds of many plants, including a high proportion of perennial grasses, germinated after rainfall of 5 ins. in February 1947, whereas none germinated on unprotected scalds. *C. terminifera* was reported in 1947–48 for the first time in north-western Tasmania, to which it had evidently flown from the mainland, some 400–500 miles distant. Following exceptionally heavy rains and floods, evidence was obtained in the autumn of 1949 of local swarm formation in the flood plain of Cooper's Creek, New South Wales, which is thus confirmed as an outbreak area.

Studies were begun in July 1946 on the Lamellicorns that are injurious to pastures. The most important is *Aphodius howitti* Hope, which is common in

improved pasture in Victoria, New South Wales, South Australia and Tasmania. It is stated in the second report that severe infestation by it in New South Wales is largely confined to the southern tableland. Improved pasture with leguminous plants [**31** 264] and sheep camps are preferred for oviposition and tall, dense pasture is avoided, but oviposition may be heavy in natural pasture if other sites are not available. Trees, hedges and, to a less extent, fences and isolated posts seem to induce settling and oviposition. Pastures with bare patches were found during the next season to be preferred for oviposition ; mature females alight on the bare ground and enter the soil at the edge of the vegetation. The discontinuous distribution of infestation is attributed to the gregariousness of the ovipositing females and their discrimination in selecting oviposition sites, but may also result from continued oviposition over a flight period of several months. Damage by the larvae was slight in New South Wales in 1948, probably owing to heavy rain in summer and autumn of that year. Mortality appears to be largely due to fungi attacking the eggs and to asphyxiation of both eggs and young larvae in water-logged soil ; older larvae are more resistant to moisture. The larvae move over the ground only during rain or when the ground is wet. At other times, damage is confined to the neighbourhood of the burrows, and total damage and rate of development are roughly correlated with autumn and winter rainfall. The larvae ingest a certain amount of soil, and where this is rich in organic matter, develop faster than would be expected from the quantity and quality of the vegetative cover. In the laboratory, larvae kept without dung or vegetation, but provided with leaf mould, made excellent progress. A DDT dust applied to pasture at a rate of 3·3 lb. p,p′isomer per acre in August 1946 gave almost complete mortality of young larvae and remained effective for at least 18 months [**37** 221] ; reinfestation was still only slight in 1948–49.

Experiments on the control of *Halotydeus destructor* (Tucker) were resumed in Western Australia in 1946–47 and continued throughout the three years. Mixtures containing 2 per cent. DDT or BHC (benzene hexachloride containing 12 per cent. γ isomer) in superphosphate applied to pastures of subterranean clover [*Trifolium subterraneum*] at a rate of 2 cwt. per acre in 1946 gave over 95 per cent. mortality, and in similar tests in early 1947 remained toxic for at least 2½ and 1–2 months, respectively. The same immediate high mortality was obtained when the concentration and rate of application were halved. The yields in 1948–49 from plots treated in 1946 with 2 per cent. DDT at 2 cwt. per acre were considerably greater than those from the controls, and infestation was still very low ; lots treated at half the rate showed a smaller increase in yield, though infestation in them was about the same. Infestation in soil treated with 0·1 and 0·5 per cent. DDT, both at 1 cwt. per acre, remained very low for three months and negligible for six, respectively, in 1947–48. In the following year, populations in pasture treated with 0·5 per cent. DDT were only one-fifth those in untreated pasture, but considerably greater than those in pastures treated with 1 per cent. DDT ; similar yields were obtained from both pastures for a year after treatment. In 1947–48, reinfestation from untreated pasture occurred at a rate of 11 yards in two months. In 1948–49, populations were considerably reduced and yields increased threefold in pastures subjected to slow intense burning, but light, rapid burning was ineffective. It was observed in 1946–47 that *Smynthurus viridis* (L.) was killed by the BHC but not by the DDT [*cf.* **37** 102], whereas the reverse was true of *Biscirus lapidarius* (Kramer), which is predacious on it.

In work on the insect vectors of plant viruses, *Orosius argentatus* (Evans), which transmits yellow dwarf of tobacco, was caught in mechanical nets at Canberra between 27th August and the end of December in 1946, and was most abundant in September. In tests, it transmitted the virus to plants of

six species, of which *Datura stramonium*, *D. tatula* and tomato were found naturally infected in the field, in 1947–48, and of 15, including weeds common in tobacco-growing districts, pasture plants and ornamentals, all of which were symptomless carriers, in glasshouse experiments in 1948–49. It is stated in the second report that the Jassids remain infective for at least 16 days after removal from diseased plants and in the third that they can pick up and transmit the virus in feeding periods of one and five minutes, respectively. Studies on the witches' broom virus of lucerne were begun in the spring of 1947 in New South Wales. This disease is stated in the third report to be prevalent throughout inland areas of Queensland, New South Wales, Victoria and South Australia, and has also been recorded in the north of Western Australia. It causes virescence of the floral parts similar to that typical of the virus of tomato big bud [**32** 65], and may possibly be a strain of this virus. *O. argentatus* was the commonest of nine Jassids collected in the spring of 1947 from fields of diseased and healthy plants, and in preliminary experiments it transmitted the virus from lucerne to *Datura stramonium*, *Malva parviflora* and beet. In field experiments on the control of tomato spotted wilt in tobacco at Sydney and Canberra in 1946–47, attack by infective thrips in plots planted with three times the usual number of plants [*cf.* **36** 45] and sprayed with 0·1 per cent. DDT at intervals of one or two weeks was estimated to be only one-quarter that in unsprayed plots. In normally planted plots at Canberra that were sprayed at weekly intervals with 0·1 per cent. DDT until thinning time and subsequently with DDT or BHC, the DDT gave significant control of the disease and reduced infection by about 50 per cent., while the BHC was of little value. The incidence of the disease was very light in 1947–48, and it was practically eliminated from triple-planted plots by thinning. The plots were surrounded by a trap belt of tick beans [*Vicia faba*] that was frequently sprayed with DDT to destroy thrips, and this appeared to give good protection. The disease was epidemic in potatoes in New South Wales and Victoria in 1946–47, of no importance in 1947–48 when thrips populations were low, and again of little importance in 1948–49. Investigations in that year showed that *Thrips tabaci* Lind., the only known vector present, was the second most numerous thrips on potato.

In work on orchard pests in the Capital Territory in 1946–47, emulsion sprays containing 0·06 per cent. DDT or less were inferior to sprays of 0·5 per cent. lead arsenate and 1 per cent. white oil against *Cydia pomonella* (L.) on apple. The dicyclohexylamine salt of dinitro-o-cyclohexylphenol incorporated in two of the cover sprays of DDT prevented outbreaks of *Bryobia praetiosa* Koch but not of *Tetranychus telarius* (L.) (*urticae* Koch) ; hexaethyl tetraphosphate gave complete mortality of both mites, but did not prevent reinfestation by *T. telarius*. In 1948–49, four applications of a spray of 0·01 per cent. parathion (E605) at intervals of 3–4 weeks beginning on 19th November gave satisfactory control of *T. telarius* throughout the season. At midsummer, severe infestations of mites on trees that had been sprayed with DDT and no acaricide were effectively reduced by an application of 0·02 per cent. parathion. A parathion emulsion applied as a finely atomised spray at a rate to give 0·45 gm. parathion per 1,000 cu. ft. killed the active stages of *T. telarius* on glasshouse plants, but not the eggs ; 0·35 gm. also gave very high mortality.

Work on the control of cabbage insects was concluded in 1947–48, and the main findings have been noticed from another source [**38** 167]. A preparation of which the active ingredient was fluoro-DDT was effective against *Plutella maculipennis* and *Pieris rapae* in 1946–47, and in 1947–48, sprays containing 0·1 per cent. DDD (dichlorodiphenyldichloroethane) or DDT were as effective against them as one containing 0·1 per cent. DDT and 0·05 per cent. nicotine sulphate ; sprays containing 0·1 per cent. chlordan or toxaphene were significantly inferior, and a dust of 1 per cent. toxaphene still more so. In

field tests against *Gnorimoschema operculella* on potato at Canberra in 1946–47 [*cf.* **36** 217], a spray of 0·1 per cent. DDT was more effective in protecting the haulms from attack than an aerosol giving an equivalent dosage of DDT. A spray of 0·4 per cent. Ryanex (prepared from the ground wood of *Ryania speciosa*) was not significantly better than no treatment. The percentages of tubers infested at harvest in plots in New South Wales that were dusted twice at an interval of three weeks with 2 per cent. DDT were reduced from 17·1–38·5 to 7·2–15·9.

Laboratory experiments on the control of termites (*Coptotermes lacteus* (Frogg.) and *Eutermes exitiosus* Hill) in 1947–48 showed that pentachlorophenol confers a high degree of protection on wood and other materials treated with it and that phenol-formaldehyde resins are more effective than urea-formaldehyde resins. The order of decreasing resistance to *E. exitiosus* of five native hardwoods was shown in 1948–49 to be *Tristania conferta, Eucalyptus acmenioides, E. microcorys, E. maculata,* and *E. pilularis.* Creosote and 5 per cent. pentachlorophenol applied to the soil at a rate of 0·5 gal. per cu. ft. both gave complete protection for 12 months, whereas lead arsenate and arsenic trioxide at 2 oz. per cu. ft. were ineffective. Work on the protection of timber from attack by *Lyctus brunneus* (Steph.) was begun in 1946–47, and tests in the two following years showed that sheets of green veneer that were momentarily immersed in a cold solution of boric acid or borax and then stacked in blocks for a few hours before drying were immune from attack. It is also stated in the third report that incorporating BHC in the glue used for bonding plywood gave complete protection for 2½ years, even at low concentrations.

A campaign for the eradication of *Iridomyrmex detectus* (F. Sm.) from Canberra was carried on throughout the whole period, and it is stated in the third report that dusts of 2 per cent. DDT or 0·5 per cent. γ BHC [*cf.* **36** 218] effectively destroyed the ants in treated nests, but did not prevent reoccupation of the sites by those that were absent at the time of treatment. Two applications at an interval of a week, however, completely eliminated colonies. Treatment was most successful when carried out during March and April, before hibernation begins. In preliminary experiments on the control of *Taeniothrips simplex* (Morison) on *Gladiolus* in 1946–47, an emulsion containing 0·1 per cent. DDT proved effective and was significantly superior to one containing 2 per cent. BHC (0·024 per cent. γ BHC) and to the standard tartar-emetic bait-spray. A spray of 0·1 per cent. hexaethyl tetraphosphate was of no value.

Digestion in larvae of the clothes moth, *Tineola* [*bisselliella* (Humm.)], was investigated in 1948–49. They were found to digest wool keratin in which all sulphur is in the form of disulphide linkages [*cf.* **39** 5], and sulphydryl groups were first detected in the alimentary canal about one-third of the way along the mid-gut ; a dehydrogenase was active in the same region, and there was a marked difference in the histological structure of the epithelium at that point. *Blattella* [*germanica* (L.)] and larvae of *Pieris rapae* ingested wool fibres of the length (100 μ) to which larvae of *Tineola* cut them before ingesting them, but did not digest them to any extent.

HARRIS (W. B.). **Control of Green Peach Aphis.**—*J. Dep. Agric. S. Aust.* **53** no. 10 pp. 443–445, 3 figs. Adelaide, 1950.

Myzus persicae (Sulz.) is the most serious insect pest of peach in South Australia and sometimes increases to large numbers and defoliates the trees in spite of insecticidal treatment, especially if the spring is favourable. The chief measure employed is a winter ovicidal spray of tar distillate or similar material, but growers have tended to reduce the strength of this under the impression that it damaged the fruiting wood. This damage has been shown, however, to be caused by the fungus, *Clasterosporium carpophilum* (*Coryneum beijerinckii*),

which had until recently not been of much importance in the State, and tests were carried out in 1949 on the effect of the reduced concentrations of the ovicide on the control of the Aphid. The trees, which were ten years old, were sprayed on 5th July with 2 and 3 per cent. tar distillate and counts on 8th October showed that the numbers of colonies per tree averaged 12·7 and 3·6, respectively. The difference between these figures was significant.

The effect of spring treatments was also tested, and the sprays were applied on 11th November to trees that had been almost defoliated by the Aphid following a dormant spray of 2 per cent. tar distillate ; light rain fell after the spraying. The mortality percentages, which were assessed visually after four days, were 5 and 15 for 0·1 and 0·2 per cent. DDT as a wettable powder, 99 for 0·06 per cent. HETP [hexaethyl tetraphosphate], and 90 and 95 for 0·01 and 0·03 per cent. E605 [parathion]. In view of the failure of the wettable DDT, a further test was carried out to compare wettable-powder and emulsion sprays of DDT against a heavy population of the Aphid. The sprays were applied on 18th and 30th November, respectively. By the latter date, winged Aphids were beginning to migrate and new shoots were appearing on the trees. Four days after treatment, the percentage kills were 25 for 0·2 per cent. DDT in the wettable powder and 85 for 0·1 per cent. in the emulsion.

It is concluded that a dormant spray of less than 3 per cent. tar distillate would not prevent heavy infestation by *M. persicae* if conditions in the spring were favourable. The efficiency of the HETP was increased by exposure of the Aphids through defoliation of the trees, and it would be less effective when they are protected by rolled leaves, as in the earlier stages of infestation. Parathion would also not necessarily be so effective earlier in the season. Wettable DDT has given satisfactory control in seasons in which infestation has not been so severe, and its failure against a heavy infestation may have been due to insufficient persistence of the deposit on such a smooth-leafed tree as peach.

Till (M. R.). **E605 Injury to Duchess Pears.**—*J. Dep. Agric. S. Aust.* **53** no. 12 p. 542, 1 fig., 1 ref. Adelaide, 1950.

Conspicuous injury was caused to pear fruits in South Australia by sprays of E605 [parathion] applied against the codling moth [*Cydia pomonella* (L.)]. It consisted of ring scars surrounding unaffected skin, was similar to that described for a DDT emulsion spray [*R.A.E.*, A **38** 168], and was apparently the result of the concentration and evaporation of spray droplets. The trees had received four thorough applications on calm, mild days, the calyx and first cover sprays being omitted, and the estimated percentages of fruits injured were 95 for 0·045 and 0·03 per cent. parathion, 5 for 0·015 per cent. parathion and 0 for 0·1 per cent. DDT as a wettable powder. The volatile components of the solvent used for the parathion are thought to have been responsible.

Friend (A. H.). **Further Experiments on the Control of the Queensland Fruit Fly** (*Strumeta tryoni*).—*Agric. Gaz. N.S.W.* **60** pt. 6 pp. 307–308, 334, 1 ref. Sydney, 1949.

An account is given of further experiments carried out in 1948–49 on plum and pear in two localities in New South Wales for the control of *Dacus* (*Strumeta*) *ferrugineus tryoni* (Frogg.) [*cf. R.A.E.*, A **38** 482]. On plum, bait-sprays consisting of a toxicant and 2 lb. sugar in 4 gals. water were splashed on to the trees on 21st and 24th December and 1st and 5th January, and ripe, firm plums were examined on 6th–7th January. The percentages of fruits free from egg punctures were 91·3 for 2 oz. tartar emetic as the toxicant, 82·37 for

1 oz. nicotine sulphate with 2 oz. DDT (20 per cent. emulsion), 68·17 for 0·2 oz. E605 [parathion] and 67·86 for 1 oz. HETP [hexaethyl tetraphosphate], as compared with 50·33 for no treatment. No scorching of the fruit or foliage was observed. The great differences between treatments were probably evident because of a decline in fruit-fly activity that occurred during the test period, for all the earliest ripening fruits were attacked at the beginning of it, regardless of treatment, and 90 per cent. of the crop on the controls was free from attack a week after the test fruits were picked.

On pear, cover sprays of 0·2 per cent. DDT from a 50 per cent. wettable powder and 0·2 per cent. parathion from a 74 per cent. emulsion concentrate were compared with bait-sprays of 2 oz. tartar emetic or 0·2 per cent. parathion with 2 lb. sugar in 4 gals. water at a time when fruit-fly activity was high. The cover-sprays were applied on 2nd, 9th and 16th February, and the bait-sprays on 2nd, 5th, 10th, 13th, 17th and 19th February. Fruits were picked on 21st February and examined in mid-March. The percentages of undamaged fruits, the numbers of egg punctures per fruit and the percentages of fruits containing larvae averaged 2·1, 3·17 and 0 for the parathion cover spray, 19·9, 2·37 and 34·9 for the DDT cover spray, 34, 1·41 and 2·4 for the parathion bait-spray, 59·9, 0·65 and 14·8 for the tartar-emetic bait-spray and 0·4, 5·42 and 74·3 for no treatment. Parathion caused some scorching of the leaves, but it was not serious. All treatments were significantly better than none by all three criteria, except the parathion cover spray, which gave significant reductions for the last two only. Baits, collectively, were significantly more effective than cover sprays in preventing puncturing, and the parathion bait than the parathion cover spray. There was no significant difference between the two bait-sprays or between the two cover sprays in this respect, but the parathion cover spray gave a significantly greater reduction in infested fruits than DDT, only 10 per cent. of the eggs hatching and all the larvae dying at or soon after hatching. The parathion bait-spray was not significantly inferior in this respect.

In laboratory tests on the effect of parathion, eight of nine fruit-flies caged with a skin surface from a pear treated with the parathion cover spray were dead within 48 hours, as were all of nine caged with flesh taken 1–10 mm. beneath the skin of the same pear, but all those given similar flesh from a pear treated with DDT were alive after 120 hours, when observations were discontinued. The test was repeated after the parathion-sprayed fruit had been kept in cold storage for two months, and it was then found that the skin was more toxic than the flesh, which showed no measurable effect.

O'Loughlin (G. T.). **The Apple Root Borer—Control Experiments at Kyabram.** —*J. Dep. Agric. Vict.* **48** pt. 1 pp. 35–38, 7 figs. Melbourne, 1950.

Information on the life-history of *Baryopadus squalidus* (Boh.), an Australian weevil that attacks *Citrus* and deciduous fruit trees in Victoria and New South Wales, is incomplete [*R.A.E.*, A **23** 182 ; **24** 446], but the females are known to lay up to 500 eggs each in batches of 20–60 on the leaves over a period of about six months in spring and early summer, and eggs hatched in 18–22 days in the laboratory at an average temperature of 75°F. Evidence suggests that the period spent by the larvae in the soil attacking the roots is at least four years ; newly hatched individuals can survive without food for a week or more. The available control measures have usually not proved adequate, and with the advent of DDT and BHC (benzene hexachloride) [*cf.* **35** 6], a long-term investigation of the bionomics and control of the weevil was begun on apricot in the Goulburn Valley, Victoria, in 1948. The treatments tested against the emerging adults comprised the use of cylindrical traps made of flywire 8 ins. wide fastened round the trunks at the upper edge and with the lower edge

hanging loose, which were sprayed with 0·1 per cent. wettable DDT every three weeks, and two cover sprays of 0·1 per cent. DDT applied on 23rd September and 27th October, in accordance with emergence data obtained from the traps. Weevils were caught in the latter from 9th September to 29th November, mostly in mid-September, and the trees bearing them and the sprayed trees were free from all weevils, leaf damage or eggs in early November, whereas the controls showed all three. It was also sought to test the effect of soil treatment with BHC on newly hatched larvae entering the ground, and 12 oz. 10 per cent. BHC powder in 20 oz. ammonium sulphate per tree was applied with a manure spreader. This had no effect on the emerging adults, but its effectiveness against the larvae would not be known for several years.

Interim recommendations for control comprise the use of the flywire traps treated with DDT to indicate emergence of the weevils and the application of the sprays of 0·1 per cent. DDT to all trees in the area at monthly intervals for as long as emergence persists.

WILSON (G. F.). **Two injurious Aphid Pests of Conifers.**—*J. R. hort. Soc.* **73** pt. 3 pp. 73–78, 2 pls., 2 figs., 14 refs. London, 1948.

Notes based partly on the literature are given on the appearance of the alate and apterous viviparae and the bionomics and control of *Rhopalosiphum* (*Neomyzaphis*) *abietinum* (Wlk.) and *Cinara* (*Neochmosis*) *cupressi* (Buckt.), which attack spruce (*Picea* spp.) and *Cupressus macrocarpa*, respectively, in Britain and reduce their value as ornamental trees. Both are most abundant on trees on badly drained or very dry soils and in exposed situations. *R. abietinum* is widely distributed ; a list is given of ten species and varieties of *Picea* that are attacked by it at Wisley and six that are not. *P. abies* and *P. sitchensis* are the most susceptible, but whereas infestation results in the complete defoliation of the latter, it only causes browning of the needles of the former. The extent of the damage varies not only with species but also from tree to tree. Mild, damp winters favour attack, and colonies of the Aphids sometimes develop as early as January and February during mild weather. Observations at Wisley between 1921 and 1947 indicate that infestation is severe every three or four years. Apterous females are present throughout the year, and the alate females appear in spring and are most abundant during June–August. The Aphids are attacked by various natural enemies, mostly predators, but these exert little control since they are not active in spring. The most effective control measure is a winter application of 5 per cent. tar distillate directed to the lower surface of the leaves and shoots, where the Aphids are most numerous. Spring and summer infestations are readily controlled by sprays of derris, pyrethrum, or nicotine with soap, and by nicotine dusts at temperatures above 65°F. Dusts are more effective than sprays on closely planted nursery stock.

Cinara cupressi has been less frequently recorded and is probably often overlooked. It occurs on the stems, branches and shoots of *Cupressus macrocarpa*, and when abundant causes serious die-back. The vigour of infested trees is reduced by the feeding of the Aphids and also by their honey-dew and the sooty moulds that develop on it. The Aphids are present on the trees throughout the year, but are most abundant in March, May–July and September. They do not appear to be attractive to predacious insects. They can also be controlled by a thorough application of 5 per cent. tar distillate during January–March or by a nicotine dust applied at temperatures exceeding 65°F.

CHAUDHURI (R. P.). **Studies on two Aphid-transmitted Viruses of leguminous Crops.**—*Ann. appl. Biol.* **37** no. 3 pp. 342–354, 15 refs. London, 1950.

The results are given of laboratory experiments in England on the transmission of two viruses obtained from naturally infected plants in the field

and considered to be those of pea mosaic and pea enation mosaic, and on their host range and general properties. The pea mosaic virus was transmitted by *Myzus persicae* (Sulz.), *Macrosiphum onobrychis* (Boy.) (*pisi* (Kalt.)), *M. solanifolii* (Ashm.) and *Aphis fabae* Scop., but not by *Rhopalosiphoninus* (*Hyperomyzus*) *staphyleae* Koch, and it was transmitted by Aphids and by mechanical inoculation to pea, sweet pea (*Lathyrus odoratus*), broad bean (*Vicia faba*), vetch (*V. sativa*), subterranean clover (*Trifolium subterraneum*) and crimson clover (*T. incarnatum*), but tobacco, *Nicotiana glutinosa*, french bean, soy bean, tomato, red clover (*T. pratense*), white clover (*T. repens*), lucerne and ornamental lupins were not susceptible. It was a non-persistent virus [*cf. R.A.E.*, A **29** 26 ; **35** 204] and was most readily transmitted when the vectors were made to fast and were then given a short infection feed. Vector efficiency was not increased by increases in preliminary fasting beyond 15 minutes or by increasing the period of infection feeding beyond one hour. Most Aphids became non-infective within 15 minutes when feeding, but fasting Aphids remained infective for three hours. *M. onobrychis* and *A. fabae*, which occur commonly on pea and broad bean, were less efficient vectors than *Myzus persicae*, which does not, and this may be connected with differences in inactivation of the viruses by the Aphids [**28** 301]. Seeds from infected plants produced healthy seedlings.

Pea enation mosaic virus was transmitted by *Macrosiphum onobrychis*, *Myzus persicae*, and *Macrosiphum solanifolii*, which were decreasingly effective in the order shown, but not by *R. staphyleae*, and it was transmitted to pea, soy bean, sweet pea and crimson clover. Broad bean, red clover, vetch, tobacco, *N. glutinosa*, french bean, white clover and subterranean clover did not become infected. The virus persisted in *M. onobrychis* and *Myzus persicae* for more than 140 hours ; its transmission was not affected by preliminary starvation. No transmission was obtained until at least four hours after Aphids had left infected plants ; usually the latent period exceeded one day, and its duration was apparently unaffected by the length of the infection feeding.

Broadbent (L.), Chaudhuri (R. P.) & Kapica (L.). **The Spread of Virus Diseases to single Potato Plants by winged Aphids.**—*Ann. appl. Biol.* **37** no. 3 pp. 355–362, 8 refs. London, 1950.

The following is almost entirely the authors' summary. Young potato plants in pots exposed in the open in southern England near plots of potatoes for limited periods at intervals during the summers of 1944–46, became infested with large numbers of winged Aphids only during warm, calm and dry weather ; *Myzus persicae* (Sulz.), was the principal species. Although visited by Aphids during May and June, when much of the spread of viruses occurred in neighbouring potato crops, few of the potted plants became infected then. Most became infected in July, when alate Aphids were leaving neighbouring potato crops. Widely different proportions of the exposed plants became infected in different years ; in two of the three years, many more plants were infected with virus Y than with leaf-roll virus.

Posnette (A. F.) & Robertson (N. F.). **Virus Diseases of Cacao in West Africa. VI. Vector Investigations.**—*Ann. appl. Biol.* **37** no. 3 pp. 363–377, 1 graph, 17 refs. London, 1950.

Posnette (A. F.). **Virus Diseases of Cacao in West Africa. VII. Virus Transmission by different Vector Species.**—*T.c.* pp. 378–384, 14 refs.

These two parts of a series [*R.A.E.*, A **38** 378, etc.] contain accounts of laboratory experiments on factors affecting transmission of strains of the virus

complex (cacao virus 1 or *Theobroma* virus 1) that causes swollen-shoot disease of cacao in West Africa by a single vector species and the possible relations between strains of the virus and different vector species, respectively. In those described in the first, the test insect was *Pseudococcus njalensis* Laing, the test plants were cacao beans [**37** 86] with one cotyledon removed, and virus strains A and M were used. The following is the authors' summary. Increasing the number of *P. njalensis* per test plant increased the infection rate with cacao virus 1A and 1M to 95 per cent. with 25 insects. Young leaves with the red vein-banding symptoms were better sources of virus than mature leaves, and there was evidence of virus localisation in the plant. It was estimated that *P. njalensis* nymphs took about 16 minutes to penetrate plant tissues with their stylets. Infection rates increased with time of test feeding up to 50 minutes. The virus was non-persistent [*cf.* **35** 204] in the feeding insect, but persisted up to 36 hours in insects starved after the infection feed. Starvation before the infection feed increased the infection rate with infection feeds up to 10 hours, after which the infection rate with pre-starved insects declined to the level attained by unstarved insects.

In the experiments recorded in the second part, *Ferrisia virgata* (Ckll.), *Paraputo ritchiei* Laing, two species of *Phenacoccus* and nine of *Pseudococcus* were tested as vectors of one or more of 17 strains of the virus from the Gold Coast, Nigeria or the Ivory Coast. One strain (S) was not transmitted by any of the four species with which it was tested. Of the others, *P. njalensis* transmitted all, *P. citri* (Risso) 14 of 15 with which it was fully tested and *Pseudococcus* sp. near *celtis* Strickland all of ten ; *P. bukobensis* Laing transmitted 11 of 12 (not including S), *Ferrisia virgata* 12 of 16, *Pseudococcus* sp. near *gahani* Green 3 of 4 and *P. adonidum* (L.) (*longispinus* (Targ.)) 2 of 16. Of species tested with one or two strains only, *P. brevipes* (Ckll.) transmitted two, and *Pseudococcus* sp. near *masakensis* James, *Phenacoccus* sp. (H6418) and *Paraputo ritchei* the particular one with which they were tested. All these species occur in West Africa on cacao in the field except *P. brevipes*, which is common on pineapple but survived on cacao for only two days when transferred to it in the greenhouse, and *Pseudococcus* sp. near *masakensis*, which was collected in the Gold Coast on *Cola chlamydantha*, from which it transmitted the local virus to cacao [**38** 378]. *Phenacoccus* sp. (H 6418) is rare at Tafo, but causes leaf crinkle, the development of red blotches on the young leaves, and thickening of the stem similar to those due to virus infection ; the stem thickening with enlarged stipules might be confused with witches' broom resulting from fungus infection. A similar species, *Phenacoccus* sp. (H 6435), was found causing considerable damage to cacao in Zanzibar. *Pseudococcus* sp. near *celtis* was collected in the district of Nigeria in which strain S occurs. This strain does not cause the development of swellings, and the leaf symptoms differ from those due to other West African strains in that very little red pigment is produced in the young leaves and small clearings occur regularly along the mid-ribs and secondary veins ; in cases of severe infection, the veins are drawn towards the mid-rib as in the nutritional disease known as " sickle leaf ". Similar symptoms have been reported from Venezuela. Some evidence was obtained of the existence of non-transmitting strains of *P. citri*. Of the 15 strains tested with both *F. virgata* and *P. adonidum*, the former transmitted strains A, F_1, H, K, N, O_1, O_2, O_3, P, X, Y and (in one experiment only) M, while the latter transmitted only C and M ; neither transmitted strains D and R. No other specific relation was found.

On the basis of this work, it is concluded that control measures applied against the vectors should be directed, not only against the common one (*P. njalensis* in the Gold Coast), but also against other species of this and related genera [*cf.* **36** 110]. The ability to act as vectors of those that are sufficiently common to spread the disease within the crop has been tested, but other genera

may transmit viruses from wild host plants [**38** 378], on which the common vectors are less prevalent. The importance of controlling outbreaks of the mild strains is pointed out, since plants may be infected by two or more strains, which would be transmitted by the common vectors as a complex.

SHEALS (J. G.). **Observations on Blindness in Oats.**—*Ann. appl. Biol.* **37** no. 3 pp. 397–406, 13 refs. London, 1950.

The following is virtually the author's summary. The relative importance in North Wales of various factors said to cause blindness in oats was investigated. It is concluded that a direct attack on the developing panicles by larvae of *Oscinella frit* (L.) and by adults and larvae of thrips (mainly *Limothrips cerealium* (Hal.) and *Stenothrips graminum* Uzel) was of little importance in causing the blindness encountered [*cf. R.A.E.*, A **2** 382 ; **9** 170 ; **21** 367]. Most of the blindness appeared to result from adverse physiological conditions probably operative during early growth. Varying varietal susceptibility to blindness was noted, and the effect on the subsequent panicles of an early insect attack on the vegetative parts of the plant is discussed.

JOHNSON (C. G.). **Infestation of a Bean Field by *Aphis fabae* Scop. in Relation to Wind Direction.**—*Ann. appl. Biol.* **37** no. 3 pp. 441–450, 1 pl., 3 figs., 1 ref. London, 1950.

Infestation of bean fields by *Aphis fabae* Scop. is commonly thought to originate at the edges and to be most injurious there. In order to investigate this theory, observations were made in Hertfordshire in 1948 on the rate and date of departure of alatae of *A. fabae* from selected bushes of *Euonymus* and *Viburnum* and of the arrival of migrant alates of the "*fabae*" complex [*cf. R.A.E.*, A **35** 39] on adhesive traps round a field crop of broad beans [*Vicia faba*] and on a small plot in a neighbouring garden. No very large, sudden, mass departure from the winter food plants or arrival at the traps occurred, and it is concluded that the alates leave the winter food-plants as they become adult. During the period of primary migration up to 14th May, the wind was mainly from northerly and easterly directions and the Aphids were most numerous on the north and north-east sides of the crop and almost absent from the opposite ones. After 14th May, when the wind was mainly from easterly directions, they were most abundant along the north-east and south-east edges. Plants bordering narrow paths that ran through the crop were often heavily infested, and it was found that smoke produced at the edge of the crop when the wind was parallel to it entered these pathways and moved along them, at right angles to the wind direction, for a considerable distance. Infestation towards the end of June was heaviest along the north-east edge of the field, and it is tentatively concluded that the distribution of infestation is correlated with wind direction during the period of primary migration, though other factors such as local wind eddies during migration, the movements of migrants within the crop, and the effects of natural enemies affect its final distribution.

KENNEDY (J. S.) & BOOTH (C. O.). **Methods for Mass Rearing and investigating the Host Relations of *Aphis fabae* Scop.**—*Ann. appl. Biol.* **37** no. 3 pp. 451–470, 7 figs., 23 refs. London, 1950.

A method is described for the continuous mass rearing of apterous and alate parthenogenetic females of *Aphis fabae* Scop. throughout the year. They are reared on broad bean (*Vicia faba*), and the breeding unit consists in the main of a row of 11 rearing cages containing clumps of plants and placed in sequence over a horizontal ventilation shaft. The Aphid colonies are initiated

on successive days, and each day the oldest colony is removed and replaced by a newly germinated clump infested by transferring to it 100 apterae from the next oldest colonies. This is done by means of an insulation cage, and the newly infested rearing cage is then moved to the beginning of the row. The shoots bearing the colony removed are placed on a newly germinated clump in an alata-maturing cage. This cage contains eight clumps of which the oldest is discarded when the new one is introduced. The young alatae fly up to the light roof and are collected from it. Supplementary cages are used for starting subcultures. All the cages are kept in a small heated greenhouse with supplementary lighting to give a 16-hour day in winter and maintain the production of summer forms. By this method, some hundreds of apterae and thousands of alatae are produced each day. Such a culture, begun in October 1946 with a single apterous female, was continued without a break until the time of writing, in February 1950.

The paper also includes descriptions of a mechanical aspirator for handling and rapidly counting large numbers of Aphids without damaging them, and of a technique for host-transference experiments that enables individual leaves to be compared as host-units for Aphids. Small metal cages of two types are used, both easily attached to the leaves in their natural positions. One, which confines the Aphids to a part of a single leaf and is used chiefly for determining the relative reproductive rates on different leaves, consists of three brass rings supported one above the other, of which the upper and middle ones grip the leaf and the lower one, which has a floor of black bolting silk, contains the Aphids ; the middle ring is attached to an adjustable support. The Aphids can be readily examined through the bolting silk, using a small dental mirror. The other encloses equal areas of two different leaves between which the Aphids can move freely and is used for studying behaviour preferences. It comprises an upper plastic leaf-clamping piece with two circular holes in it, a metal main plate, also with two circular holes, that rests against the lower surface of the leaves and supports the whole, and, below it, an Aphid container consisting of an oval plastic wall piece, a plastic floor support, and a floor of bolting silk. Since in food-preference tests it is desirable to eliminate light as a factor, the cages are darkened by covering them with an upper and a lower metal plate. The factors affecting the results and the interpretation of the latter are discussed.

EATON (J. K.) & DAVIES (R. G.). **The Toxicity of certain synthetic Organic Compounds to the Fruit-tree Red-spider Mite.**—*Ann. appl. Biol.* **37** no. 3 pp. 471–489, 20 refs. London, 1950.

The following is virtually the authors' summary. The acaricidal activity of 90 synthetic organic compounds was investigated in the laboratory. Considerable differences were found between the winter eggs, the summer eggs and the adult females of the fruit-tree red-spider mite, *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi* auct.), in their susceptibility to many of the compounds, but azoxybenzene and n-dodecyl thiocyanate were appreciably toxic to all three stages. Of the compounds showing promise against summer eggs and mites, bis-(p-chlorophenyl) methyl carbinol and 4-chloroazobenzene were the best, being highly toxic to both summer stages. Of the remainder, diphenylsulphone, 4-chlorodiphenylsulphone, azobenzene and hydrazobenzene were highly ovicidal, while C_{12}-C_{13} alkyl thiocyanates and sec.-dodecyl thiocyanate gave high kills of the adult female mite.

Relationships between molecular structure and acaricidal activity were sought. In a series of compounds characterised by the presence of two benzene nuclei connected by certain bridging groups, it has been found that activity to the summer stages of the mite can be influenced by alterations to the bridging

group and by substitution in the benzene nuclei. Maximum activity appears to be associated with chlorine substitution in the para position in one nucleus and also with compounds of this type having unsubstituted nuclei.

ELLIOTT (M.), NEEDHAM (P. H.) & POTTER (C.). **The insecticidal Activity of Substances related to the Pyrethrins. I. The Toxicities of two synthetic Pyrethrin-like Esters relative to that of the natural Pyrethrins and the Significance of the Results in the Bioassay of closely related Compounds.**—*Ann. appl. Biol.* **37** no. 3 pp. 490–507, 13 figs., 19 refs. London, 1950.

The following is almost entirely the authors' summary. The toxicity as contact insecticides of the esters of *dl*-3-methyl-2-allyl-cyclopent-2-en-4-ol-1-one with the natural *d-trans-* and the synthetic *dl-cis-trans*-chrysanthemum monocarboxylic acid [of which the second ester is known as allethrin (*R.A.E.*, A **38** 505)] was compared with that of the natural pyrethrins. The comparison was carried out on adults of *Phaedon cochleariae* (F.) and *Oryzaephilus surinamensis* (L.), larvae of *Plutella maculipennis* (Curt.), and apterous adults of *Macrosiphum solanifolii* (Ashm.) and *Aphis fabae* Scop. The compounds were applied as aqueous sprays with the addition of 0·1 per cent. sulphonated lorol and 10 per cent. acetone in a spraying tower [**29** 591] to insects on circles of " Tricoline " cloth in petri dishes. It was found that the figures for both the absolute and the relative toxicities of these compounds varied with the species of test-insect used.

The factors involved in this variation are discussed. The extremes of variation of relative toxicity for the compounds with the natural and (in brackets) the synthetic acid were from about one-eighth (one-sixteenth) as toxic as the pyrethrum standard when *M. solanifolii* was the test insect to nearly four times (twice) as toxic as the standard for larvae of *P. maculipennis*. The fully synthetic material was about half as toxic as the compound with the natural acid to these two insects and *Phaedon cochleariae*, but considerably more than half as toxic to *O. surinamensis*. It is pointed out that while it is widely recognised that large differences in relative toxicity may occur when the effects of chemicals of widely different structure and mechanism of action are compared on a number of different test species, the fact that these differences may also occur with related chemicals with, presumably, a similar mechanism of action, has not been clearly stated. Even when the differences in relative toxicity are taken into account, the two synthetic pyrethrin-like esters still show high insecticidal activity.

It seems reasonable to suppose from the results that economic commercial synthesis of pyrethrin-like insecticides is not impossible.

BLACKITH (R. E.). **Bioassay Systems for the Pyrethrins. III. Application of the Twin Cross-over Design to crawling Insect Assays.**—*Ann. appl. Biol.* **37** no. 3 pp. 508–515, 12 refs. London, 1950.

In this part of a series on methods for the bioassay of pyrethrins [*R.A.E.*, A **38** 88], the author describes the twin cross-over experimental design, which has not apparently been so far used for insecticidal assay, and demonstrates its suitability for use with crawling insects ; it is also of value for flying insects confined to surfaces. The method consists in exposing groups of test organisms to solutions of the standard and test toxicants, each at a high and a low concentration and, after a period for recovery, repeating the experiment but reversing the toxicant solutions, so that the pair of groups that were originally exposed to the test solutions are now exposed to the standard ones and the pair that received the high concentrations receive the low ones. The method cannot be used with materials that cause death or irreversible paralysis, but appeared suitable for use with the pyrethrins, so a preliminary experiment

was carried out to examine the effect of pyrethrins in various concentrations upon *Calandra granaria* (L.). Weevils that had been starved for 12 hours were exposed on filter papers impregnated with 0·1 ml. white oil alone or containing 0·2 or 0·4 per cent. pyrethrins for 12 hours at 30°C. [86°F.], when the percentages that were paralysed were 0, and about 42·2 and 76·1, respectively. After 24 hours in clean wheat, the weevils were again starved and each batch was divided into groups and again exposed to pyrethrins, at concentrations of 0·17–0·52 per cent. The percentages paralysed after 12 hours were of the same order among all weevils exposed to the same concentration, regardless of previous treatment, and paralysis of *C. granaria* by pyrethrins therefore appears to be completely reversible. The weevils were able to pair and to lay viable eggs during the recovery period.

The use of the method is illustrated by a comparison of pyrethrins alone and with a synergist, and the analysis of the results is discussed. The method is economical of test insects and is particularly effective with laboratory cultures of insects with fairly stable tolerance levels or small homogeneous batches of insects collected in the field. It is more precise than alternative methods in which batches are exposed only once, since the temporal variations in tolerance during the experimental period are less than the heterogeneity between batches, but the results of the two halves or of one of them only can if necessary be analysed so as to base the estimate of error on the sampling variance. The relative efficiency of these two methods of analysing the same data is illustrated in a table.

DE JONG (J. R.). **Field Method for the Determination of the Particle Size of Oil Mists.**—*Ann. appl. Biol.* **37** no. 3 pp. 516–526, 1 pl., 5 graphs, 4 refs. London, 1950.

The method of determining the size and distribution of spray droplets described in this paper was devised in Holland to evaluate recently developed types of equipment for spraying plants with concentrated solutions of toxicants in mineral oils applied at low rates and to determine the most effective droplet-size for use under different conditions. It can be used in the laboratory or the field and consists in collecting spray droplets on glass plates coated with a thin film of a material, such as mannitan monolaurate, octadecylamine or Drifilm 9987 (organo-silicons), on which they do not spread, taking micro-photographs of the sprayed plates, and projecting them on to a horizontal screen, where the diameters of the droplets are measured by means of scale divisions applied on transparent materials on which the corrected diameters of the drops are indicated for different enlargements. By this method, 500 oil drops can be classified within an hour. The diameter of the air-borne droplets is calculated from the measured diameter by a method that is described, and from it the volume of each drop is calculated. Frequency curves showing the percentages of the total number of measured drops in different size classes and volume-distribution curves indicating the percentages of the total volume of oil on the plate contributed by the drops in each class are then constructed. In field studies on the fineness of the deposit on plants, the glass plates should be distributed at random over the sprayed area at a suitable height from the ground, and in estimates of the dispersion of a liquid by different nozzles, they should be arranged to give average distribution.

The method was tested in the field with an atomiser having five spray nozzles, each with nine orifices 0·6–0·8 mm. in diameter, and a helicopter fitted with a spraying boom with eight atomiser nozzles, in which the diameter of the orifice was 3 mm., and in the laboratory with a spraying apparatus having an adjustable nozzle [*R.A.E.*, A **38** 150] and gave characteristic results.

HEWLETT (P. S.) & PLACKETT (R. L.). **Statistical Aspects of the independent joint Action of Poisons, particularly Insecticides. II. Examination of Data for Agreement with the Hypothesis.**—*Ann. appl. Biol.* **37** no. 3 pp. 527–552, 2 graphs, 18 refs. London, 1950.

The following is based on the authors' summary of this second part of a series [*cf. R.A.E.*, A **37** 364]. Methods are described for discovering whether a mixture of two poisons is as toxic as predicted on the hypothesis of independent joint action [*loc. cit.*]. These include χ^2 tests and a procedure for finding the maximum likelihood estimate of the coefficient of correlation in resistance to poisons. The methods are illustrated by data from insecticidal tests. In these, adults of *Tribolium castaneum* (Hbst.) were sprayed with, or exposed to films of, different insecticides in solution in Shell oil P 31. The insecticides were pyrethrins, DDT and γ BHC (benzene hexachloride) applied alone or in pairs. The statistical analysis of the results showed mixture mortalities within the range for independent action in the case of films and sprays of pyrethrins and DDT and films of DDT and BHC, but too high for independent action in the case of sprays of DDT and BHC and both films and sprays of pyrethrins and BHC.

In a discussion of these findings, it is concluded that independent joint action should be regarded as a special case of a more general type of joint action [*cf.* **28** 199], and the term " dissimilar joint action " is proposed for the latter. A general method of approach, based initially on physiological considerations, is advocated for the conception and development of hypothesis of the joint action of poisons.

STODDARD (R. B.) & DOVE (W. E.). **Cinerin I Homolog tested. A preliminary Evaluation of the insecticidal Effectiveness of the completely synthetic allyl Homolog of Cinerin I.**—*Soap & sanit. Chem.* **25** no. 10 pp. 118–121, 161, 2 graphs, 5 refs. New York, N.Y., 1949.

In experiments with the completely synthetic allyl homologue of cinerin I [the ester now known as allethrin (*cf. R.A.E.*, A **38** 505 ; **39** 50)], sprays were prepared by dissolving the compound in odourless kerosene at selected concentrations and dusts by impregnating selected concentrations on an organic base and diluting with pyrophyllite. Pyrethrum standards of comparison were prepared from an extract of pyrethrum flowers of known pyrethrins content. Tests on adult house-flies [*Musca domestica* L.] were made by a modification of the turntable method [*cf.* B **26** 246] and by the small-group Peet-Grady method [*cf.* B **37** 5, 89] and those on adult males of the German cockroach [*Blattella germanica* (L.)] by a direct-spray method. Surface deposits were tested against adults of the confused flour beetle [*Tribolium confusum* Duv.], and dusts were applied against nine species of insects affecting market-garden crops by a modified settling-tower method [*cf.* A **29** 557].

In all tests against house-flies by both methods, the slope of the dosage-mortality curve was steeper for allethrin than for pyrethrins, and the lines for the two materials crossed, indicating that allethrin is less toxic than natural pyrethrins at low concentrations and more toxic at higher ones [but *cf.* B **39** 25]. They were equally effective at concentrations of about 150 mg. per 100 ml. in tests by the Peet-Grady method and at 100 mg. per 100 ml. by the turntable method. Allethrin is apparently considerably more effective than pyrethrins at relatively high concentrations by the turntable method, but this apparent margin of superiority practically disappears when the two materials are tested by the other method.

Against the cockroach, allethrin was inferior to pyrethrins in both initial knockdown and mortality [*cf.* B **38** 208].

Deposits of allethrin on glass plates were less effective than corresponding deposits of pyrethrins against *T. confusum*. They paralysed the insects somewhat less rapidly and permitted much more rapid and complete recovery when the insects were removed from the plates. Allethrin was less effective than pyrethrins in dusts against adults of the Japanese beetle [*Popillia japonica* Newm.], the Colorado potato beetle [*Leptinotarsa decemlineata* (Say)], the spotted cucumber beetle [*Diabrotica undecimpunctata howardi* Barber], the striped cucumber beetle [*Acalymma vittata* (F.)] and the harlequin bug [*Murgantia histrionica* (Hahn)], adults and larvae of the Mexican bean beetle [*Epilachna varivestis* Muls.], adults and nymphs of the squash bug [*Anasa tristis* (Deg.)], nymphs of the melon aphid [*Aphis gossypii* Glov.] and larvae of the corn earworm [*Heliothis armigera* (Hb.)] in all tests, though relative effectiveness varied considerably.

Lowman (M. S.), Gersdorff (W. A.) & Kelly (J. W.). **Effect of Drying Methods on Toxicants in Pyrethrum Flowers.**—*Soap & sanit. Chem.* **25** no. 9 pp. 118–121, 151, 10 refs. ; no. 10 pp. 135–136. New York, N.Y., 1949.

The following is based on the authors' summary. The results are given of experiments in which pyrethrum flowers were dried or handled prior to drying, by various methods that can be utilised when quantities of the flowers must be dealt with during the short harvest period of their highest insecticidal value. When the flowers were dried at temperatures up to 175°C. (347°F.) or stored in boxes or in sealed jars and then dried rapidly, no loss of pyrethrins was demonstrated by chemical determination and tests on *Musca domestica* L. When flowers stored in closed containers or in thick layers before drying became mouldy, there was no loss of toxicants, but serious losses occurred when the flowers became mouldy while drying in thin layers on sieves.

Flowers dried at temperatures up to 120°C. [248°F.] were of about the same appearance as those dried slowly on sieves, but higher temperatures caused a darker colour. Those kept for varying periods in the fresh state were somewhat browner in colour after drying, and those that got mouldy either before or during drying were dark and abnormal in appearance. Flowers of abnormal colour would be objectionable for the manufacture of household insecticides, but not for the preparation of agricultural dusts and sprays.

Fan (H. Y.), Cheng (T. H.) & Richards (A. G.). **The Temperature Coefficients of DDT Action in Insects.**—*Physiol. Zoöl.* **21** no. 1 pp. 48–59, 10 graphs, 16 refs. Chicago, Ill., 1948.

In view of several reported instances in which mortality of insects treated with DDT has been greater at low than at high temperatures [*R.A.E.*, A **36** 380 ; B **34** 134 ; **35** 194 ; **36** 127], the relation between toxicity of DDT and temperature was investigated in the laboratory. The tests were carried out chiefly on larvae of *Chaoborus* sp. and *Aëdes aegypti* (L.), but larvae of *Tipula abdominalis* (Say) and adults of a crayfish, *Cambarus* sp., were also used. When immersed in colloidal suspensions of DDT at concentrations of 1 in 10, 100, 500 or 1,000 million, mortality among larvae of *Aëdes* and *Chaoborus*, both of which were highly susceptible, increased with rising temperatures at the two higher concentrations, but decreased at the lower ones. A similar relation appeared to exist for larvae of *Tipula*, which were, however, considerably more resistant to DDT, and the crayfish was too resistant to give conclusive results. Pre-treatment in dilute concentrations of DDT at low temperatures increased mortality among larvae of *Aëdes* and *Chaoborus* in subsequent tests at higher temperatures ; pre-treatment at high temperatures

had little effect on the mortality of *Aëdes* in subsequent tests at lower ones, but results obtained with *Chaoborus* were inconclusive. When DDT at suitable concentrations in emulsified solution was injected into *Cambarus* sp. and larvae of *Aëdes* and *Tipula*, there was no increased mortality at low temperatures. It thus appears that the negative temperature response with dilute suspensions was due to some property of the body-wall. It is concluded from a discussion that the cuticle is probably responsible and that its action is possibly that of concentrating DDT by absorption processes, since earlier investigations have indicated that DDT can be removed from suspension by arthropod cuticle but not by living tissue.

El Khishen (S. A.). **Determination of Ethylene Oxide and Methods of its Recovery from fumigated Substances.**—*J. Sci. Food Agric.* **1** no. 3 pp. 71–77, 3 figs., 22 refs. London, 1950.

The following is the author's summary. Previous attempts to determine ethylene oxide [*cf. R.A.E.*, A **21** 111 ; **32** 184] are surveyed and critically investigated. New methods of analysis have been suggested and certain modifications of existing methods applied to suit conditions of experiments. New methods for the detection and approximate determination of the fumigant in an atmosphere containing the gas have been established. Methods of recovery of ethylene oxide from grain and sultanas have been studied ; part of the oxide has been shown to be readily recoverable and the remainder only with great difficulty.

The relation between water content in the fumigated substance and the amount of fumigant retained has been studied, on the supposition that ethylene oxide reacts with the water in the material to form ethylene glycol. However, attempts to isolate and determine the glycol in the fumigated substance have failed. Various methods for the recovery of the firmly held portion of ethylene oxide have been devised and a procedure is described by which 92 per cent. of the total fumigant added can be recovered and determined.

Contrary to the opinion of many authors, ethylene glycol is not formed in fumigated grain ; practically the whole of the fumigant is retained as ethylene oxide. It seems likely that a small proportion not exceeding 8 per cent. is combined with some constituents of the fumigated substance ; the proportion so combined depends on the period of contact and on the temperature to which the fumigated substance is subjected.

Gorringe (B. S.). **Determination of Fumigants. XXI.—Preliminary Experiments on the Sorption of Mercury Vapour by Wheat.**—*J. Sci. Food Agric.* **1** no. 4 pp. 114–118, 7 figs., 19 refs. London, 1950.

The following is the author's summary. An ultra-violet absorption method for the determination of mercury vapour in air is described. The apparatus incorporates a special ultra-violet filter. The amount of mercury vapour sorbed by clean pyrex glass was found to be small compared with that sorbed by wheat, and to have no relation to the time of exposure. The sorption of mercury vapour by English wheat of moisture content 13–18 per cent. at temperatures of 20–30°C. has been studied. It is concluded that most of the mercury sorbed is firmly retained by reaction with the wheat tissues.

Annual Reports of the Forest Insect Survey . . . 1946, 1947, 1948, 1949.—86 pp., 20 maps ; 102 pp., 21 maps ; 124 pp., 27 maps ; 122 pp., 27 maps. Ottawa, Dep. Agric. Canada, 1947, 1948, 1949, 1950.

These reports on the status of pests of forest and shade trees in Canada in 1946–49 are arranged on the same lines as those for previous years [*R.A.E.*, A **36** 240, etc.], various authors dealing with the individual Provinces or parts of them.

PLUMB (G. H.). **The Adult Feeding Habit of some Conifer-infesting Weevils.**—*Canad. Ent.* **82** no. 3 pp. 53–57, 5 figs., 17 refs. Guelph, Ont., 1950.

In late May 1945, the author found five adults of *Magdalis austera* Fall and two of *M. hispoides* Lec. feeding on the needles of white pine [*Pinus strobus*] in Connecticut. Although these species occur across the northern range of the United States and southern Canada, *M. hispoides* had not previously been recorded from Connecticut, and the only form of *M. austera* taken there in past years on pine was var. *substriga* Fall. The way in which the weevils fed and the subsequent appearance of the injured needles are described, and records of somethat similar feeding on pine needles by three other weevils, each of a different genus, are reviewed.

ANDISON (H.). **The Bramble Leafhopper, *Typhlocyba tenerrima* H.-S. (Homoptera : Cicadellidae), a destructive European Insect new to the Pacific Northwest.**—*Canad. Ent.* **82** no. 3 pp. 68–70, 2 refs. Guelph, Ont., 1950.

In July 1947, *Typhlocyba tenerrima* H.-S. was found causing serious injury to the leaves of loganberry in the Brentwood area of Vancouver Island, British Columbia, and a survey showed that this Jassid was widely distributed in the southern part of the island and also occurred on raspberry and blackberry. In 1948, it again injured loganberry, and it was also observed on the mainland in the lower Fraser Valley, and in 1949 it was found on wild blackberry north of Victoria. It is widely distributed in Europe, but earlier records from North America are doubtful.

The nymphs and adults produce a white stippling on the leaves of brambles throughout the growing season. The eggs, which overwinter in the canes, hatch during the first two weeks in May, and the young nymphs feed on the undersides of the newly developed leaves. On loganberry, this generation completed its development during the first two weeks of July, when picking is in progress, and nymphs of the next began to injure the foliage of old and new canes about mid-August. Adults were numerous on the new canes during the first two weeks in September and probably fed as late as November. Damage was most severe in August and September. Mature leaves that have been attacked become mottled-yellow and concave on the under surface. In southern Vancouver, where the rainfall is low in June–August, damage to the foliage affects the size and development of the fruit and the growth of the canes, and severe infestation prevents the fruit from maturing.

In mid-May 1948, sprays were applied at 100 gals. per acre to a 10-year-old blackberry plantation in the Keating area, when the peduncles were 4–6 ins. long, and examination of leaves in the second week in July showed that the percentages injured were 100 for no treatment, 9·7 for 1 lb. 25 per cent. parathion, 12 for 1·5 lb. 50 per cent. DDT, 13·5 for 2·5 gals. lime-sulphur, 24·6 for 5 ozs. 40 per cent. dinitro-o-cyclohexylphenol and 53·4 for 0·5 pint 50 per cent. hexaethyl tetraphosphate, all per 100 gals. Dinitrocyclohexylphenol and lime-sulphur caused some injury to the leaves.

In the lower Fraser Valley, a 3 per cent. DDT dust applied by growers to raspberry and loganberry during the first two weeks in May (when the blossom buds are separating) and again three weeks later (immediately prior to blossom) controlled *T. tenerrima* and *Byturus bakeri* Barber [*cf. R.A.E.*, A **31** 5] with no serious increase in mites such as has occurred in other areas after the use of DDT. A spray of 10 gals. lime-sulphur per 100 gals. water applied to blackberry in the dormant stage, followed by another at 2 gals. per 100 gals. water when the peduncles were 6–8 ins. long, gave good control of *T. tenerrima*, septoria leaf spot [*Septoria rubi*] and the redberry mite [*Aceria essigi* (Hassan)]. Spray injury to the foliage was apparently of no great consequence.

GLENDENNING (R.). **Supplement to Processed Publication No. 52.**—2 pp., multigraph. Ottawa, Ont. [Dep. Agric. Can.], 1948.

This supplement to a paper on *Psila rosae* (F.) and its control on carrots in British Columbia [*R.A.E.*, A **35** 365] consists of a recommendation for the use of a benzene-hexachloride dust based on more recent experiments [**38** 130].

WILSON (M. C.). **A preliminary Study of the Effect of DDT on** *Aphis maidis* **Fitch and its Insect Enemies with particular Reference to** *Aphidius* (*Lysiphlebus*) *testaceipes* **(Cress.).**—*Ohio J. Sci.* **48** no. 1 pp. 30–40, 6 figs., 12 refs. Columbus, Ohio, 1948.

Advantage was taken of heavy parasitism of a large population of *Aphis maidis* Fitch on maize at Columbus, Ohio, by *Aphidius testaceipes* (Cress.) in 1945 to test the effect of treatment with DDT and other insecticides on the populations of both Aphid and parasite. In field experiments, individual heavily infested plants were treated with the insecticides, and the tassels or upper parts of the stalks enclosed in cages. In the first test, sprays of 0·5–2 lb. DDT per 100 U.S. gals. as colloidal suspensions prepared with acetone and adjuvants and 1 lb. DDT per 100 U.S. gals. as emulsified solutions in benzene and kerosene were compared with a nicotine-rotenone dust (1 per cent. rotenone in equal parts of sulphur and tobacco dust). Observations were made after 24 hours and then weekly for five weeks. Both Aphid and parasite populations were greatly reduced within 24 hours on all the DDT-treated plants and usually remained low until the end of the test, though on one of the plants that received the kerosene emulsion, there was a rapid increase of the Aphid in the third week, followed by an increase in the parasite in the fourth and a fresh decrease of the Aphid in the fifth. The reduction after 24 hours by the nicotine-rotenone dust was not nearly so great, but the Aphid disappeared after a week, leaving a greater parasite population than any of the DDT treatments. In the second test, dusts of 0·5–8 per cent. DDT were compared with the nicotine-rotenone mixture and sprays of 0·25–8 oz. DDT from the suspension or 12 oz. nicotine sulphate, both per 100 U.S. gals. Observations were made after 24 hours and twice a week for two weeks. The 4 and 8 per cent. DDT dusts almost eliminated both Aphid and parasite within a week ; 2 per cent. DDT and the nicotine-rotenone mixture were about equally effective against the Aphid, giving great reductions in a week with the parasite reduced but still present, while 0·5 and 1 per cent. DDT also controlled the Aphid in a week, with concurrent parasite reduction, but the Aphid increased again during the second week. Of the sprays, nicotine sulphate controlled the Aphid within 24 hours, leaving high parasite populations, and the highest concentration of DDT gave fair control. The weaker sprays (4 oz. DDT or less) gave temporary reductions, after which both Aphid and parasite increased in numbers.

In further tests, maize tassels bearing large numbers of parasitised Aphids and some predators were taken to the laboratory, planted in moist sand, sprayed with 0·25–32 oz. DDT per 100 U.S. gals. and caged under conditions of artificial light. Observations were made daily for a fortnight. Aphid mortality in the first two days ranged from none for the weakest spray to heavy for the strongest. The Aphid populations on the controls declined after a week, probably owing to the onset of high temperatures averaging 80°F., but this favoured the parasite. Emergence of the latter continued throughout the experiment in all cages, the numbers being roughly in inverse relation to the strength of the sprays and considerably lower for the weakest spray than for no treatment. It reached a peak in the first few days and another, lower, one 6–7 days later, and since the parasite has been recorded as completing its life-cycle in 7–15 days, these are thought to represent distinct generations.

Some of the adult parasites that came in contact with the plants treated with 4 oz. or more DDT per 100 U.S. gals. developed an acute twitching of the legs and a gradual loss of equilibrium, but no symptoms were observed prior to such contact. Adults of predacious Coccinellids, Chrysopids and Syrphids emerged in a few of the cages for all but the strongest spray.

WEBSTER (J. E.), SIEGLINGER (J. B.) & DAVIES (F.). **Chemical Composition of Sorghum Plants at various Stages of Growth, and Relation of Composition to Chinch Bug Injury.**—*Tech. Bull. Okla. agric. Exp. Sta.* no. T-30, 32 pp., 22 refs. Stillwater, Okla., 1948.

The following is based on the authors' summary of this account of investigations carried out in Oklahoma in an attempt to determine whether differences in the resistance of varieties of sorghum to injury by the chinch bug [*Blissus leucopterus* (Say)] could be correlated with differences in their chemical composition [*cf. R.A.E.*, A **29** 258]. Analyses of the content of solids, ash, certain mineral elements, sugars, nitrogen, tannins, hydrocyanic acid, and certain enzymes of several varieties were made over a period of years and gave a continuous picture of the changes that occurred in the plants and the expressed juice from the beginning of growth till the heading stage. No over-all chemical differences that could be correlated with resistance to *Blissus* were found when large numbers of varieties were compared, since those that existed between selected resistant and susceptible varieties always disappeared when a greater number of varieties was considered. The contents of tannins and hydrocyanic acid showed no correlation with resistance. There was little over-all difference in the total sugar content of immature plants of saccharine and non-saccharine varieties until heading began, and some classed as sweet sorghums were lowest in sugar content when immature. A chemical study of two varieties, each with a resistant and a moderately susceptible strain, failed to show any material differences. A study of root exudates failed to show differences in flow that could account for serious injury to plants even when some losses occur from bleeding.

JEWETT (H. H.) & TOWNSEND (L. H.). *Miris dolobratus* (**Linn.**) **and** *Amblytylus nasutus* (**Kirschbaum**)—**two destructive Insect Pests of Kentucky Bluegrass.**—*Bull. Ky agric. Exp. Sta.* no. 508, 16 pp., 8 figs., 6 refs. Lexington, Ky., 1947.

Miris dolabratus (L.) has been a pest of Kentucky bluegrass (*Poa pratensis*) in Kentucky since 1924. Investigations on its bionomics were carried out at Lexington in 1942–46 and it was then found that another Mirid, *Amblytylus nasutus* (Kirschb.), was even more numerous on the grass. Both suck the sap of the blades, stems and florets and reduce the crop of seed. *M. dolabratus* also attacks grasses of other species, but eggs of *A. nasutus* were found only in *P. pratensis*. All stages of both species are described. It was found that both have one generation a year and lay their eggs in the cavity of the stems, those of *M. dolabratus* being laid within about 6 ins. of the soil surface and those of *A. nasutus* towards the top of the stem, near the lower branches of the panicle. Oviposition by *A. nasutus* itself had no effect on seed-production. The eggs over-winter and most hatch in April. Nymphs of *M. dolabratus* completed their development in 26–36 days and those of *A. nasutus* in 30–35 days. Adults are present in May, but are short-lived, mostly dying by 1st June. The sexes were about equal in numbers. The dates on which various stages were first and last observed in the five years are shown in tables.

Mechanical stripping of the seed, as normally practised, has no effect on eggs of *A. nasutus*.

DOUTT (R. L.). **The Distribution of *Copidosoma koehleri* Blanchard (Hymenoptera : Encyrtidae).**—*Pan-Pacif. Ent.* **24** no. 1 pp. 34–35, 4 refs. San Francisco, Calif., 1948.

Copidosoma koehleri was one of the new Encyrtids in a key published by Blanchard [*R.A.E.*, A **29** 344]. It is a parasite of the potato tuber moth, *Gnorimoschema operculella* (Zell.), in Brazil (where it was apparently first recorded, as *Copidosoma* sp., in 1938 [**27** 289]), Argentina and Chile, and attempts have been made to introduce it elsewhere for the control of its host. It was imported from Chile into California early in 1945 [**35** 21] and, after mass-rearing in the laboratory, was shipped from there to Australia [*cf.* **36** 216 ; **39** 39], Bermuda [**37** 38] and Hawaii later in the same year, and to Italy in 1947.

GONÇALVES (C. R.). **Saúvas do sul e centro do Brasil.** [Leaf-cutting Ants of central and southern Brazil.]—*Bol. fitossanit.* **2** (1945) no. 3–4 pp. 183–218, 28 figs., 8 refs. Rio de Janeiro, 1947.

The author gives a list of the ten species and subspecies of *Atta* that are present in Brazil, followed by a key to the soldiers of the six that occur in the centre and south of the country and a list of these showing their distribution, with some observations and a review of the literature on their nests and the plants from which they cut leaves.

GOMES (J. G.). **Efeito das baixas temperaturas na emergência e reprodução de *Macrocentrus ancylivorus* Roh., parasito da *Grapholita molesta* Busck.** [The Effect of low Temperatures on the Emergence and Reproduction of *M. ancylivorus*, a Parasite of *Cydia molesta*.]—*Bol. fitossanit.* **2** (1945) no. 3–4 pp. 219–223. Rio de Janeiro, 1947.

In connection with the mass rearing of *Macrocentrus ancylivorus* Rohw. on *Gnorimoschema operculella* (Zell.) in California for liberation against *Cydia* (*Grapholitha*) *molesta* (Busck), the effect of storing the pupae of the parasite at low temperatures on the emergence and reproduction of the adults was studied. Batches of 100 pupae were separated from the host cocoons by treatment with sodium hypochlorite and alcohol [*cf. R.A.E.*, A **35** 174, etc.] and stored at 5, 10·5 and 17·2°C. [41 and about 51 and 63°F.] for 15 days, after which they were transferred to incubation chambers at 26·6°C. [about 80°F.] and 40 per cent. relative humidity. The numbers of males and females that emerged were 10 and 9, 31 and 23, and 34 and 40, respectively. It is thought that the alcohol treatment had some detrimental effect on emergence, since mortality was relatively high in the controls kept at 26·6°C. throughout.

The adults were fed on honey and allowed to pair, and three days after emergence, batches of both sexes were placed in flasks containing potato tubers infested by *Gnorimoschema* and their progeny observed. Of the adults from pupae stored at 5°C., a batch of 5 females and 4 males and another of 2 of each sex were given tubers infested 9 and 7 days previously, respectively, and these gave rise to 5 females and 3 males and 24 females and 14 males, the percentages of parasitism being 10·5 and 55·8. Of the adults from pupae stored at 10·5°C., two batches of 4 females and 3 males each were given tubers infested 7 days previously, and these gave rise to 18 and 47 males, respectively, and no females, the percentages of parasitism being 69·2 and 57·3, respectively. Of those from pupae stored at 17·2°C., two batches of 4 females and 3 males each were given tubers infested 5 days previously and gave rise to 0 and 1 female and 34 and

51 males, respectively, the percentages of parasitism being 75·5 and 76·4. The variety of potato used was one in which the *Gnorimoschema* larvae develop rapidly but penetrate to the interior of the tuber, which does not occur in other varieties, and this is thought to explain the decreases in the percentage of parasitism obtained with increasing time from infestation. The differences in sex ratio of the progeny are not thought to be due to sterility of the males as a result of storage at low temperatures or chemical treatment of the pupae, since the ratio was normal among progeny of individuals stored at 5°C. and at least one female from those stored at 17·2°C. must have been fertilised. No explanation is offered, and it is tentatively concluded that storage at low temperatures in the pupal stage has no harmful effect on the fecundity of the adults or the sex ratio of the progeny.

Sobral (R. P.). **Criação de saúvas " vermelhas "** (*Atta sexdens rubropilosa* **Forel) em laboratório.** [The Rearing of Leaf-cutting Ants (*A. sexdens rubropilosa*) in the Laboratory.]—*Bol. fitossanit.* **2** (1945) no. 3–4 pp. 225–231, 6 figs. Rio de Janeiro, 1947.

Atta sexdens rubropilosa Forel is reared in the laboratory in Brazil for tests of insecticides, but the method so far adopted, in which the ants form their colonies in glass jars and are allowed to move about and colonise fresh jars at will, has proved unsatisfactory, since, when the colonies become large, the ants attack the smaller colonies, move about the room in organised fashion, sometimes enter other rooms or leave the building, and even migrate entirely, so that the whole colony may be lost. A system was therefore devised in which the ants were reared in a series of earthenware jars and cages connected together by pipes of galvanised iron through which they moved. They could not escape to the outside, and fresh jars could be connected to the system or old ones removed as required. Leaves to be cut by the ants were supplied through a door. The system is described in detail, and photographs show the general arrangement.

Ferreira Lima (A. D.). **Insetos fitófagos de Santa Catarina.** [Phytophagous Insects of Santa Catarina.]—*Bol. fitossanit.* **2** (1945) no. 3–4 pp. 233–251. Rio de Janeiro, 1947.

A list is given of some 200 insects that attack cultivated plants in the Brazilian State of Santa Catarina, showing their local distribution and the plants they attack, and a few other insects, mostly parasites and predators, with the hosts of these.

Wolcott (G. N.). **Termite Repellents : a Summary of laboratory Tests.**—*Bull. P. R. Univ. agric. Exp. Sta.* no. 73, 18 pp., 11 refs. Rio Piedras, P.R., 1947.

The results of tests in Porto Rico of the resistance to *Kalotermes* (*Cryptotermes*) *brevis* (Wlk.) of wood treated by ten minutes' submersion with a large number of inorganic chemicals are discussed at some length and those of similar tests with organic compounds shown in tables are commented on more briefly. Some of them have already been noticed [*R.A.E.*, A **36** 232, etc.] ; natural constituents of wood [*cf.* **35** 375] as well as synthetic chemicals were included. The following is based on the author's summary.

The standard water-soluble wood preservatives, copper sulphate and zinc chloride, are very repellent. The most susceptible wood impregnated with as little as 0·15 per cent. copper as copper sulphate (less than 1 oz. of the chemical per U.S. gal. water) has continued immune from attack for over four years, as has also a comparable sample treated with 0·2 per cent. zinc as zinc chloride.

Many metallic salts have no repellent value at a concentration of 2 per cent. of the metals. Ferrous compounds are valueless, but ferric chloride is as repellent as zinc chloride. The chloride of cadmium is its least repellent salt ; cadmium bromide and cadmium acetate are more effective than copper sulphate. Several of the non-volatile compounds of mercury, notably mercurous sulphate and mercuric acetate, are also more repellent than copper sulphate. The fluorides of barium, lithium, sodium and potassium at concentrations of 2 per cent. fluorine are repellent, but at less than 1 per cent. fluorine they are more or less toxic. Of the fluorine compounds with the repellent metals, copper fluoride is ten times as effective as copper sulphate, and zinc fluoride ten times as effective as zinc chloride and not costly. The lack of permanence in repelling attack that was noted in a few inorganic compounds is characteristic and practically universal among organic compounds. No final prediction as to the efficiency of those that seem likely to be notably effective in permanently repelling termites was possible at the time of writing [but *cf.* **38** 200].

Wolcott (G. N.). **The Resistance to Dry-wood Termite Attack of some Central American Woods.**—*Caribb. Forester* **9** no. 1 pp. 53–54. Rio Piedras, P.R., 1948. (With a Translation in Spanish pp. 54–55 and a Summary in French p. 56.)

Additions are made to previous lists [*R.A.E.*, A **36** 169] showing the relative resistance to attack by *Kalotermes* (*Cryptotermes*) *brevis* (Wlk.) of timbers that have been tested against it in Porto Rico. The additions are based on more recent work with timbers from Central America and northern South America by F. B. Lamb ; only two showed any appreciable resistance. Two corrections are also made in the identifications of Australian timbers tested earlier. The repellent species recorded as *Syncarpia laurifolia* [*loc. cit.*] has proved to be *Callitris glauca*.

[Borkhsenius (N. S.).] **Борхсениус (Н. С.). On three Genera of Scales (Coccoidea, Diaspididae) from Central Asia.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **58** no. 2 pp. 343–344. Moscow, 1947.

Neochionaspis, gen. n., is erected for *N. kirgisica*, sp. n. (the type), which is described from black currant in Kirghizia and Kazakhstan, and [*Chionaspis*] *asiatica* Arkh., which occurs on stone fruit trees in Soviet Central Asia [*R.A.E.*, A **27** 474] and northern Persia [**34** 16].

[Kozhanchikov (I. V.).] **Кожанчиков (И. В.). On the specific Resistance of the Metabolism of Insects to Dichlorodiphenyltrichloromethylmethane.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **58** no. 2 pp. 345–348, 2 graphs, 8 refs. Moscow, 1947.

The author discusses the results of laboratory observations on the period of survival and oxygen consumption of insects of widely different habits and in different stages of development that were dusted at 20°C. [68°F.] with 5 per cent. DDT in talc at a rate providing 0·01 per cent. of their weight of pure DDT and shows the results of some of them in tables. Resistance to the insecticide varied greatly with species and stage, and it did not appear to be related to thickness or toughness of cuticle, as some insects with thin light cuticles were more resistant than others with thick tough ones, or to the structure of the nervous system, since it frequently altered in the course of development of a single stage. There was also no simple relation between resistance and oxygen consumption between species, but within a species, resistance increased directly with the rate of oxygen consumption of different stages and phases of development.

The results of more detailed experiments with diapausing eggs of *Locusta migratoria* (L.) and diapausing pupae of *Pieris brassicae* (L.) are shown on graphs. Treatment had no effect on oxygen consumption in either case until the end of diapause, when the rate increased normally for a few days and then fell to 0. The results for the locust eggs were similar to those recorded by Bodine for *Melanoplus* eggs treated with hydrocyanic acid gas, but the analogy with HCN was not complete, since this decreases the metabolism of pupae as soon as they emerge from diapause, while DDT does not. The effect of DDT on insects is thought to be due to its lipoid solubility, and since lipoids are in contact with the cell plasm, this may permit a local action at the interface. DDT may therefore act as an inhibitor of structural catalysis and thus have a more limited action than HCN.

[Sukhov (K. S.) & Vovk (A. M.).] **Сухов (К. С.) и Вовк (А. М.). The Virus of Stolbur—the causal Agent of the Mass Wilting of Peppers, Egg-plant and Potato in the South.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **58** no. 2 pp. 319–321, 2 refs. Moscow, 1947.

In 1945, the authors, working near Krasnodar, northern Caucasus, observed that a mass wilting of peppers [*Capsicum*], egg-plant [*Solanum melongena*] and potatoes that occurs widely in the southern parts of the Soviet Union and was generally ascribed to infection by *Fusarium* was preceded by symptoms resembling those of the virus disease known as stolbur [which has been considered by some authorities to be caused by the same virus as virescence or tomato big bud (*cf. R.A.E.*, A **32** 65–66)]. The symptoms observed on peppers and potatoes were chlorosis along the edges of the apical leaves, dull yellowish stains between the veins, a reduction of the surface of the leaves, which became boat-shaped, shortening of the internodes and a tendency in the petioles to assume a more vertical position than normal. In egg-plant, the reduction of the leaf surface was accompanied by chlorosis, shortened internodes, lignified stems and roots, and some lightening of the colour of the veins.

The virus of stolbur is known to be transmitted in nature by *Hyalesthes obsoletus* Sign., its only vector, and its principal reservoir is *Convolvulus*. In experiments in June and July 1946, batches of up to 50 examples of the Cixiid were taken on plants of *Convolvulus*, some of which were infected with stolbur, and caged on successive healthy seedlings of tomato, pepper and egg-plant, being left for a few hours on each. Up to 92·3 per cent. of the tomatos and over 42 per cent. of the peppers and egg-plants became infected, whereas the controls remained healthy, with the exception of a few tomato plants that had not been caged at the beginning of the test. All the infected plants wilted, the leaves eventually dried up and the plants usually died. The symptoms on tomato included a green discoloration of the flowers and woodiness of the fruits. Since the symptoms on the various plants were typical of those observed in the field, it is concluded that the latter are caused by the virus of stolbur transmitted by *H. obsoletus*. The saprophytic fungi that sometimes occur in the tissues of wilted plants are not the causal agents of the disease, but only accompany it.

[Sukhov (K. S.) & Vovk (A. M.).] **Сухов (К. С.) и Вовк (А. М.). On the Mechanism of the relative Resistance of Standard Varieties of Tomatos to Stolbur.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **61** no. 2 pp. 395–398, 1 fig., 3 refs. Moscow, 1948.

Standard tomatos are known to show considerably more resistance in the field to the virus disease known as stolbur than bush varieties, but in experiments, 90 and 100 per cent. infection of standard plants have been obtained

by means of the insect vector, *Hyalesthes* [*obsoletus* Sign. (*cf.* preceding abstract)] and sap inoculation, respectively. Investigations were, therefore, undertaken to determine the causes of the field resistance. Since the disease is contracted only through the introduction of the virus into the phloem of the plants, and its spread in nature is effected only by *H. obsoletus*, it was thought that the resistance of the plants was in some way connected with the activity of the vector. Batches of 50 examples of this Cixiid were caged at the end of June, when the buds were forming, on the stems of equal numbers of standard and bush tomatos. The insects on the standard plants began to die in 4–5 days and all were dead on the eighth day, whereas those on the bush plants survived for another 4 days. The manner of feeding of the insects was ascertained by examining sections of the stems on which they had fed. A stylet sheath is formed in feeding, and it was found that this terminated in the phloem in 64·3 and 78·7 per cent. of cases in standard and bush tomatos, respectively, and in the xylem in 35 and 15·7 per cent. The path of the sheath through the parenchyma was usually intercellular, but some feeding occasionally took place there. *H. obsoletus* is known to feed on the sap of the phloem on its other food-plants, which include tobacco, potato, chicory, parsley and *Convolvulus*, and since the decreased feeding in the phloem of standard tomatos was not due to excessive depth, the phloem of these plants is thought to be unfavourable in some respect, possibly pH [*cf. R.A.E.*, A **25** 288]. Standard tomatos are probably avoided in the field, and this, together with the increased feeding on the xylem and the increased mortality, accounts for the reduced virus transmission.

[Boĭko (A. K.).] **Бойко (А. К.). A new Kind of Myiasis in Bumble Bees.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* (N.S.) **61** no. 2 pp. 423–424, 2 refs Moscow, 1948.

In order to ascertain whether parasitism by *Senotainia tricuspis* (Mg.) in the Ukraine was restricted to honey bees [*cf. R.A.E.*, A **28** 112], wasps, hornets and wild bees were collected and examined in 1945–47. The results were negative until August 1947 when two of 77 examples of *Bombus terrestris* (L.) var. *cryptarum* (F.) and one of 43 examples of *B. lapidarius* (L.) were each found to contain a larva of the parasite. These bumble bees were collected near an apiary in which 40 per cent. of the field force was parasitised.

Plaut (N.). **Hibernation of the Olive Fly.** [*In Hebrew.*]—*Hassadeh* **30** no. 11 pp. 654–655. Tel-Aviv, 1950.

Catches of adults of the olive fly [*Dacus oleae* (Gmel.)] in trap-jars in olive groves at two different localities in Israel showed that the flies are present throughout the year and that there is a pronounced rise in the population in the second half of May. The author considers that this is not the result of larval diapause or pupal hibernation, but that a certain number of flies emerge in autumn and overwinter in the olive groves or in neighbouring areas, feeding on honey-dew and on juices of fruits and flowers. In the early summer, when olive fruits are in a suitable stage for oviposition, the overwintered flies concentrate in the groves, causing the increase observed in May. Some support for this view was provided by the fact that adults were kept alive in the laboratory for four and a half months.

Swirsky (E.). **Observations on *Aphanostigma piri* Chol. in Pear Buds.** [*In Hebrew.*]—*Hassadeh* **30** no. 11 p. 655. Tel-Aviv, 1950.

A stunting of the flower buds of pear in Israel that was formerly attributed to *Psylla pyricola* (Först.) has been shown to be caused by *Aphanostigma piri*

(Cholodk.). This Aphid reached peak numbers on the buds in February and also occurred on the twigs and branches. The damage is described.

AVIDOV (Z.) (formerly KLEIN (H. Z.)) & SWIRSKY (E.). **Control of the Citrus Mealybug on Grape Vines by organic Phosphate Preparations.** [*In Hebrew.*] —*Hassadeh* **30** no. 12 pp. 716–718. Tel-Aviv, 1950.

In experiments on control of the citrus mealybug [*Pseudococcus citri* (Risso)] on grape vines in Israel in 1949, sprays of 0·1 per cent. hexaethyl tetraphosphate, with a spreader, and 0·2 per cent. of a preparation containing 15 per cent. parathion were applied to the vines at the end of July, two months after the first appearance of the mealybugs on the leaves. Examination of fruits 17 days later showed that the percentages infested were 25 and 14, respectively, as compared with 55 in the control plot. Both compounds seemed harmless to the vines and grapes.

In 1950, a spray of 0·15 per cent. of a preparation containing 20 per cent. parathion, with a spreader, was applied on 16th June, when the insects were beginning to appear on the leaves. Examination of picked fruits six weeks later showed that the infestation of the untreated samples was 18 times as great as that of the sprayed samples. The improvement as compared with 1949 is attributed to the earlier spraying date.

Parathion also gave good control of the grape-berry moth [*Polychrosis botrana* (Schiff.)].

PUTTARUDRAIAH (M.). **Field Control of the Leaf Mite of Jola** (*Andropogon sorghum*).—*Mysore agric. J.* **26** no. 1–2 pp. 17–19, 1 pl., 4 refs. Coimbatore, 1947.

Since 1946, *Paratetranychus indicus* Hirst [*cf. R.A.E.*, A **21** 501] has caused serious injury to sorghum in Mysore. It also attacks sugar-cane there, but causes little damage, though it is an important pest of that crop in northern India. The mites occur on the lower surfaces of the leaves of sorghum and cause a red discoloration. In cases of heavy attack, the leaves and stalks become dry and the development of the ears and grains is arrested, but if infestation begins after the formation of the ears, grain development is not greatly affected.

In field and laboratory experiments on control, finely powdered sulphur applied alone or mixed with wood ash (1 : 4) [*cf.* **21** 502] gave complete mortality of mites in 48 hours, but tobacco dust, soap powder or 1 per cent. DDT or crude benzene hexachloride did not prove satisfactory. The sulphur dust should be applied to the young plants as soon as the red patches appear on the leaves. Severely infested, old and withered leaf blades should be destroyed. Two Coccinellids, *Stethorus pauperculus* (Weise) and *Scymnus nubilus* Muls., of which the former was the more numerous, were observed preying on the mites and exerted some control.

PUTTARUDRAIAH (M.). **Some Observations on the Biology and Habits of the Redgram** (*Cajanus indicus*) **Flower Bud Borer** (*Euproctis scintillans* **W.**).—*Mysore agric. J.* **26** no. 1–2 pp. 20–24, 1 pl., 2 refs. Coimbatore, 1947.

Euproctis scintillans (Wlk.), all stages of which are briefly described, is normally of minor importance in Mysore, where it attacks a variety of crops, but in November–December 1946 it caused serious local damage to the buds and flowers of *Cajanus cajan* (*indicus*). Observations on its life-history showed

that the egg, larval and pupal stages last about 5, 15 and 10 days, respectively. The eggs are laid on the leaves, chiefly on the lower surface, in masses of 8–10, and the larvae disperse soon after they hatch and enter the buds and flowers, where they feed on the sepals and stamens. Flower buds were preferred to young leaves, and each larva damaged more than one flower. During dispersal, the larvae suspend themselves on silken threads, on which they are blown by the wind.

GADD (C. H.). **Studies of Shot-hole Borer of Tea. III.—Damage to the Tea Bush.**—*Tea Quart.* **19** pt. 3–4 pp. 96–101, 7 refs. Talawakelle, 1947.

In this part of a series [*R.A.E.*, A **38** 85, etc.], the author describes the three types of secondary damage associated with infestation of tea by the shot-hole borer [*Xyleborus fornicatus*, Eichh.] in Ceylon. Two of them, wood-rot and die-back [*cf.* **32** 28], are not necessarily connected with it ; wood-rot is caused by fungi that gain access where the wood is exposed and is thought to result more often from pruning than from infestation. Where die-back is due to the latter, it is characterised by the presence of a gallery at each bud that fails to develop. The third is the breaking of branches, which is the most important and is assumed to result in a reduction in the cropping capacity of the bush [*cf.* **36** 368, etc.]

OCFEMIA (G. O.), CELINO (M. S.) & GARCIA (F. J.). **Further Studies on Transmission of Bunchy-top and Mosaic of Abacá (Manila Hemp Plant), Separation of the two Diseases, and Mechanics of Inoculation by** *Pentalonia nigronervosa* **Coquerel.**—*Philipp. Agric.* **31** no. 2 pp. 87–97, 2 figs., 20 refs. Laguna, 1947.

Plants of Manila hemp [*Musa textilis*] with symptoms of both mosaic and bunchy-top [*R.A.E.*, A **29** 316, 317, etc.] were observed in the Province of Davao, Mindanao, in 1937 and in experimental plots at Los Baños, Luzon, in 1939 and 1940, and, in consequence, reciprocal transference experiments were carried out in 1940–41 to determine the readiness with which plants infected with one virus can be infected with the other. When allowed to feed on the test plants for ten days, adults of *Pentalonia nigronervosa* Coq. from plants infected with bunchy-top transmitted it to eight of nine plants infected with mosaic, the symptoms appearing after 33–62 days, and adults of *Aphis gossypii* Glov. from plants infected with mosaic transmitted it to five of six plants infected with bunchy-top, the symptoms appearing after 13–21 days. In an experiment, in which adults of *P. nigronervosa* and *A. gossypii* were allowed to feed on plants infected with both diseases and were then transferred to healthy plants, the former transmitted bunchy-top only and the latter transmitted mosaic only.

As *P. nigronervosa* had previously been found on the roots and corms of Manila hemp during the dry season, its ability to transmit bunchy-top through the roots was tested in 1946–47. Only four of 30 seedlings became infected after Aphids from infected plants had been confined on their roots for five or six days, and it is thought that the disease is probably rarely, if ever, transmitted through the roots under field conditions.

Studies on the method of penetration of leaves by the stylets of *P. nigronervosa* showed that they are inserted either through the stomata or directly through the epidermis, and pass either through or between the cells on their way to the phloem.

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